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ERRATA.

Page 45, third line from bottom, *for* Viscuom dicthomum *read* Viscum dichotomum.
,, 55, line 5 from bottom, *after* Rolfe, sp. n., *insert* (Plate XII.).
,, 57, line 16, *erase* (Plate XII.).
,, 67, last line but one, for *Habenaria Elliotii* read *Holothrix madagascariensis*.
,, 281, line 17, for *Dœmonorops* read *Dæmonorops*.

Plate 12, *for* Habenaria Elliotii *read* Holothrix madagascariensis.

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Pages 263, 264 to be cancelled and the annexed substituted.

THE JOURNAL

OF

THE LINNEAN SOCIETY.

New and little-known Madagascar Plants, collected and enumerated by G. F. Scott Elliot, M.A., B.Sc., F.L.S.

[Read 5th June, 1890.]

(Plates I.–XII.

The following novelties were collected by me chiefly at Fort Dauphin in the extreme south-east of the island of Madagascar. I have to express my indebtedness, first to those who have taken complete charge of some of the orders—Professor A. Cogniaux, Professor Radlkofer, Mr. R. A. Rolfe, Dr. O. Beccari, Mr. C. B. Clarke, and Professor Hackel; and also to those who have assisted me in undertaking the remainder, especially Mr. J. G. Baker, whose manuscript Flora has been of the very greatest service, Dr. H. E. Baillon, who assisted me in very many doubtful cases, Prof. D. Oliver, Mr. N. E. Brown, and others who have helped me on various occasions.

DILLENIACEÆ.

Tetracera madagascariensis, var. nov. Tree in woods, Fort Dauphin, 2553!

Cyclea madagascariensis, *Baker*. On bushes in thickets, Fort Dauphin, 2648!

In fruit (previously only known in flower).

MENISPERMACEÆ.

Burasaia australis, sp. n.

Frutex, ramis tetragonis nitidis albidis (junioribus striatis brunneis) glabris, foliis sæpissime 3-foliolatis longe petiolatis demum reflexis, pulvinulo lignoso incrassato, foliolis lanceolatis acutis vel obtusis vix petiolulatis coriaceis glabris margine sub-revoluto, pedunculis axillaribus elongatis paucifloris, bracteis minutis, pedicellis elongatis, carpellis 3 fusiformibus parvis, stigmatibus sessilibus.

A shrub or small tree. Bark of the older branches white and glistening. Leaves variable; petiole often flattened and suberous at the articulation of the leaflets, usually 4–5 cm. long, but sometimes the last few leaflets of the annual shoot are almost or quite sessile or even reduced to one; terminal leaflet usually 6 cm. long and 2·5 cm. broad; the lateral 4–5 cm. long and broader at base on lower margin. Peduncle about 20 cm. long, bearing 8–20 scattered flowers; pedicels 1–2·5 cm. Carpels about 3 mm.

Near Fort Dauphin, 3082!

CAPPARIDEÆ.

Cadaba madagascariensis, *Baill.* (Not in Herb. Kew.)
Woods near Fort Dauphin, 2991!

Mærua nuda, sp. n.

Frutex, ramis erectis virgatis aphyllis minute striatis basi tumidis glabris, floribus terminalibus racemosis breviter pedicellatis, bracteis bracteolisque minutis, sepalis lanceolatis concavis acutis margine ciliato, petalis 0, filamentis sepala æquantibus vel paullo superantibus, stigmate subsessili, bacca fusiformi coriacea vix torulosa.

Branches rigid, marked by minute parallel striæ, slightly expanded at base. Flowers few, 3–4 at the ends of the branches. Bracts small, triangular; bracteoles minute; pedicels about 8 mm. long. Sepals about 1 cm. long and 3 mm. broad. Capsule cylindrical, about 3·5 cm. long and 1 cm. broad, coriaceous, narrowed at the base.

Arid country of Antandroi to south of Fort Dauphin, 2958!

Cratæva Greveana, *Baill.*, var. (Not in Herb. Kew.)
Fort Dauphin, 2671!

VIOLARIÆ.

IONIDIUM BUXIFOLIUM, Lam.
Open sandy meadows, Fort Dauphin, 2377!

ALSODEIA PAUCIFLORA, *Tul.* In woods, Fort Dauphin, 2506! Previously only found by Commerson.

BIXINEÆ.

APHLOIA DELTOIDEA, *Baill.* Previously found only by Commerson. Fort Dauphin, 2512!

PORTULACACEÆ.

TISONIA BAILLONI, sp. n.

Arborea, foliis oblongo-lanceolatis obtuse acuminatis breviter petiolatis glaberrimis, venis venulisque prominentibus, margine flavo incrassato subrevoluto, pedunculis brevibus, bracteis ovatis ciliatis, pedicellis numerosis prope basin articulatis, sepalis cordato-orbicularibus reduplicato-valvatis glabris, corolla 0, antheris oblongis, stylis 3 liberis.

A tree with glabrous striate branches. Leaves (excluding petiole) 9–13 cm. long and 4–5 cm. broad; petiole about 1 cm.; veins prominent on both surfaces, densely reticulate (about five pairs of lateral veins). Peduncles about 1 cm.; bracts about 5 mm., broad at base, with a tuft of hairs in the axils; pedicels below articulation 3 mm. long, above 7–8 mm. Sepals 3, about 1 cm. broad and the same in length. Ovary ovoid.

Woods near Fort Dauphin, 2590!

Distinguished from *T. glabrata*, Baill., in Bull. Linn. Soc. Par. i. 572, by the sepals and inflorescence.

TISONIA CORIACEA, sp. n.

Arbor, ramis griseis corrugatis hirsutis, foliis variis ellipticis vel oblongis etiam obovatis cuspidatis vel obtusis denticulato-serratis coriaceis subglabris margine revoluto, racemis folia æquantibus vel brevioribus multifloris omnino pilosis, bracteis ellipticis parvis, bracteolis minutis acuminatis, pedicellis prope basin articulatis, sepalis cordato-orbicularibus pubescentibus.

A forest tree; branches covered with elongated lenticels. Leaves quite glabrous and shining above, but with a few scattered

hairs on the lateral veins below, usually 6–9 cm. long and 4·5–6·5 cm. broad; petiole 1 cm. Sepals pubescent, with reticulate raised veins about 1 cm. in length and the same in breadth. Ovary densely hairy.

Woods near Fort Dauphin, 2744!

Distinguished from all the other species by its serrate leaves.

TALINELLA DAUPHINENSIS, sp. n.

Frutex, ramis corrugatis glabris, foliis ovatis vel lanceolatis obtusis vel sæpius acutis breviter petiolatis glabris flaccidis, paniculis terminalibus subcorymbosis, bracteis linearibus membranaceis, calycis segmentis 4 orbicularibus, filamentis æqualibus 15–20, ovario obovato-applanato, stylis subelongatis.

A straggling shrubby plant glabrous in all parts; branches red and irregularly furrowed. Leaves rather variable, sometimes almost obovate, usually 3–6 cm. long and 1·5–3·5 cm. broad; petiole under 5 mm.; texture dense, almost fleshy, usually covered above and below with raised circular (? calcium) glands; slightly revolute at the edge. Bracts about 3 mm. Flowers globose, 3 mm. in diameter. Sepals red, glabrous, with prominent reticulate veins. Styles as long as the capsules.

Woods and thickets near Fort Dauphin, 2972 *a*! 2716! 2551! 2679!

(*Cf.* Baillon in Bull. Linn. Soc. Par. i. 569.)

HYPERICINEÆ.

ELLÆA ARTICULATA, *Spach*. (Not in Herb. Kew.)

Near Fort Dauphin, 2354!

PSOROSPERMUM VERTICILLATUM, sp. n.

Frutex, ramis griseis glabris, foliis oblanceolatis sæpissime acutis discoloribus (axillis junioribus dense rufo-tomentosis) demum glabris margine revoluto, cymis axillaribus laxis pseudo-dichotomiis sæpius 6-floris ad furcas hirsutis, sepalis lanceolatis nigro-lineatis margine dorsoque sparse ciliatis, petalis oblongis interne villosis, disci squamis 5 oblongis carnosis, staminibus 5-adelphis.

A shrub with grey bark (when young the branches are smooth and red). Leaves opposite or more usually aggregated at the ends of contracted branches; the young buds and petioles rusty tomentose; dots either absent or scattered; leaves usually 5–8 cm. long and 1·5–2·5 cm. broad, with a very short petiole. Peduncles

about 1 cm., pedicels 1·5 cm. long; cymes with a few scattered hairs and a dense hairy tuft in each fork. Sepals with 5–6 conspicuous black lines. Petals 7–8 mm. long, dotted with glands. Staminal bundles with 3–6 anthers in each.

Shrub in woods, Fort Dauphin, 2331!

GUTTIFERÆ.

SPHÆROSEPALUM CORIACEUM, sp. n. (Plate I.)

Arborea, ramis rugosis glaberrimis sulcatis, foliis oblongis emarginatis coriaceis venulis prominentibus glabris, pedunculis terminalibus, paniculis pinnati-ramosis tenuiter pilosis, sepalis 4 globosis orbicularibus externe villosis coriaceis margine membranaceo, petalis 4 obovato-oblongis membranaceis, staminibus sub 1-seriatis, ovario villoso, stylo simplice primum deflexo.

A forest tree with greyish glabrous bark. Leaves (excluding petiole 1–2 cm. long) about 9–13 cm. long and 6–7 cm. broad; stipules caducous; veins prominent on both surfaces; lateral veins about 10 on each side, with very closely reticulated veinlets. Peduncles about 9 cm. long, with 2 or 3 pairs of opposite branches, each of which ends in a 6–10-flowered subumbellate cyme with pedicels 1–1·5 cm. long; inflorescence covered with short silvery hairs. Flowers in bud globose, about 7 mm. in diameter. Calyx rigid. Corolla yellow.

Woods, Fort Dauphin, 2818!

OCHROCARPUS PARVIFOLIUS, sp. n.

Arborea, ramis oppositis rarius ad nodos incrassatis flavis (saltem junioribus), foliis oppositis vel 4-natis obovatis vel oblanceolatis brevissime petiolatis basi cuneatis sæpissime obtusis margine revoluto, pulvinulis lignosis cupularibus, pedunculis subnullis, pedicellis cernuis, bracteis ovatis parvis, calyce primum globoso glanduloso-apiculato demum fisso bipartito, petalis 4, interioribus angustis, exterioribus orbicularibus, staminibus 4-adelphis, antheris numerosis.

A tree with smooth irregularly furrowed bark. Leaves usually 3·5–6·5 cm. long and 1·5–2·5 cm. broad, sometimes almost acute, thick in texture, with about 15 pairs of lateral veins running into the revolute margin, and which are transversely crossed by a set of dark venules. Buds about 5 mm. in diameter; pedicels 5-8 mm.; peduncles minute; flowers when expanded about 1 cm. in diameter. Stigma scarlet.

Woods near Fort Dauphin, 2710! 2840!

TERNSTRŒMIACEÆ.

Asteropeia Bakeri, sp. n.

Arborea, ramulis glabris rugosis rubris, foliis obovatis obtusis breviter petiolatis coriaceis glabris margine revoluto, calycis pubescentis segmentis oblongis apice truncatis rigidis, petalis quam sepala latioribus membranaceis, capsula parva nitida.

A timber-tree with red branches covered by small lenticels and marked by conspicuous leaf-scars. Leaves 3–5 cm. long and 2–3 cm. broad, very thick and coriaceous, obscurely veined, with a prominent yellow cuticular margin and very short petiole. Calyx-segments about 6 mm. long, black, pubescent on the back. Stamens 15, united for about 1 mm. at base. Capsule 3 mm. in height, globose at base, and obscurely 3-sided at apex.

Woods, Fort Dauphin, 2537 ! 2334 !

Asteropeia sp. præcedenti valde affinis. A valuable timber, "Fanoola mena," 2393 !

Asteropeia sp. an Bakeri ? A valuable wood, "Fanoola fotsy."

I have followed Dr. Baillon in putting this genus in Ternstrœmiaceæ rather than Samydeæ (*cf.* Bull. Linn. Soc. Par. i. 561).

CHLÆNACEÆ.

Sarcolæna pilosa, *Baill.*, syn. *Xerochlamys pilosa*, Baker.
Dry ground, Tapia Groves, Lake Itasy.

Sarcolæna eriophora, *Baill.* (Not in Herb. Kew.)
Fort Dauphin, 2704 !

Schizolæna exinvolucrata, *Baker.*
Woods, Fort Dauphin, 2841 !

Leptolæna parviflora, sp. n.

Frutex ramosissimus, ramis corrugatis, junioribus hirsutis demum glabratis, foliis ovatis basi sæpius rotundatis acutis vel cuspidatis breviter petiolatis undulatis glabris, floribus paucis (4–5) ad apices ramorum subracemosis subsessilibus, involucro ovoideo basi turbinato ferrugineo-tomentoso 6–10-dentato, sepalis late ovatis inclusis hirsutis, petalis ligulatis brunneo-flavis reflexis, ovario hirsuto.

A shrub or small tree with red bark ; the young shoots striate

with a few white hairs in the striæ. Leaves rather variable, 2–3 cm. long and 1–1·5 cm. broad; petiole 2 mm.; involucre when mature about 7 mm. long and 5 mm. broad; sepals about 5 mm., ovate, externally hairy; petals 9–10 mm. long, less than 2 mm. broad. Ovary eventually protruding from the involucre, very hairy. Style exserted, with stigma expanded and concave.

Woods near Fort Dauphin, 2554! also 2713!

Distinguished from *L. pauciflora* and *L. turbinata*, Baker, by the much larger leaves and tomentose involucre, and from *L. Bernieri*, Baill., by the turbinate base of the involucre.

LEPTOLÆNA ? an TURBINATA, *Baker* ?

Also allied to preceding species, 2706!

LEPTOLÆNA RUBELLA, sp. n.

Frutex, ramis dense rufo-tomentosis, foliis parvis ovatis basi attenuatis apice obtusis brevissime petiolatis exceptis, petiolis ferrugineis glabris, floribus numerosis subcorymbosis parvis, bracteis ovatis caducis, involucris basi turbinatis dense ferrugineo-tomentosis apice circ. 8-dentatis, sepalis immaturis, longe villosis staminum cupula brevissima.

A branching shrub with greyish bark densely red-pubescent when young. Leaves 1·5–2 cm. long and 1–1·5 cm. broad, glabrous (except the petiole). Racemes terminal, many-flowered; involucre about 4 mm. long and 2 mm. broad; sepals much more hairy than in *L. parviflora*.

Woods near Fort Dauphin, 2369!

MALVACEÆ.

HIBISCUS FERRUGINEUS, *Cav.*

One of those only found by Commerson, and in Herb. Mus. Par. only.

Outskirts of woods, Nempoy, Fort Dauphin, 2566! 2573!

HIBISCUS MYRIASTER, sp. n.

Fruticosa, ramis dense scabro-tomentosis, foliis cordatis subpalmatis breviter 2–4-lobis obscure dentatis longe petiolatis, venis paginæ superioris cum facie inferiore tota pilis brunneis stellatis interspersis, floribus axillaribus breviter pedicellatis, bracteolis in epicalycem cupularem breviter 7–8-dentatum connatis, calyce truncato-campanulato obsolete 5-dentato, corolla externe (etiam parte inferiore interne) villosa quam calyx ad duplo longiore,

corollæ segmentis quam tubus longioribus, columna longe exserta, stylis elongatis reflexis villosis, capsula lignosa villosa.

A shrub, scabrous and tomentose in all parts. Leaves obscurely and irregularly dentate, pedately nerved, usually (excluding petiole, which is 9–10 cm. in length) about 10–12 cm. long and 13–15 cm. broad. Pedicels 2–3 cm. long. Epicalyx about 8 mm. long; calyx 15 mm. long and almost as broad. Corolla 3·5 cm. long and 2·5 cm. in diameter, with the staminal column projecting 2 cm. out of the throat.

Forests, "Tanjete," Fort Dauphin, 2444!

Easily distinguished from the other Madagascar species by its peculiar tomentum and leaves.

DOMBEYA AUSTRALIS, sp. n.

Fruticosa, ramis striatis puberulis, foliis lanceolatis acutis vel rarius obtusis petiolatis glabris margine serrato subrevoluto, stipulis parvis triangularibus acuminatis caducis, pedunculis axillaribus folia æquantibus vel paullo superantibus sæpius subumbellate 5-floris, floribus pedicellatis basi 2–3-bracteolatis, bracteolis lineari-lanceolatis caducis, sepalis lanceolatis demum reflexis externe stellato-pubescentibus apice calloso, petalis obovatis vel obcordatis dense reticulato-venosis.

A shrub with grey branches. Leaves about 7–9 cm. long and 2–3·5 cm. broad, petiole more than 1 cm.; nerves about 7–8 pairs; serrations blunt and thickened at the tip. Sepals ovate-triangular 4–6 mm.; petals yellowish brown, rather longer than the sepals. Anthers elongate-ovate; filaments united for about 1 mm. at base.

Woods, Fort Dauphin, 2668!

Near *Dombeya xiphosepala*, Baker, but easily distinguished by the narrower leaves and much smaller flowers.

GERANIACEÆ.

OXALIS (§ BIOPHYTUM) MOLLIS, sp. n.

Fruticosa, ramis elatis subdichotomiis dense sericeo-tomentosis, foliis verticillatis (sæpius 13nis) internodos æquantibus pinnatis 20–25-jugis, foliolis subrhomboideis vel oblongis basi truncatis sessilibus utrinque appresse villosis apice minute calloso apiculatis, pedunculis folia æquantibus, bracteis ovatis hirsutis in capitulum parvum congestis, floribus primo sessilibus demum

pedicellatis, pedicellis prope basin articulatis, sepalis 7-nerviis dorso hirsutis.

A rather tall shrub (up to 3 feet) softly and densely hairy in all parts. Leaves 4–7 cm. long; leaflets increasing in size very slightly; those two thirds from the base largest; usually about 5 mm. long and 3 mm. broad; stipules linear, inconspicuous. Sepals 3–7-nerved, acute; petals rather longer. Filaments flattened at base.

Near Fort Dauphin, 2487!

Oxalis (§ Biophytum) Commersonii, *Baill.*

A very reduced form of this species, previously only found by Commerson (*cf.* Bull. Linn. Soc. Par. i. 598). Leaves in my plant 4–6 cm. long, with leaflets only 1·5 cm. long.

Near Fort Dauphin, 3079!

RUTACEÆ.

(By Prof. L. Radlkofer.)

Toddalia Ellioti, *Radlk.*

Inermis, glabra; rami novelli subtriangulares, resina obducti; folia sparsa, unifoliolata (ut in *Teclea simplicifolia*, Baillon, Bull. Soc. Linn. de Paris, 1886, p. 591), foliolo exobovato vel oblongo cuneato (4–5 cm. longo, 1·5 cm. lato) obtuso vel emarginato, margine revoluto, tenuiter pinnati-nervio cum petiolo (vix 1 cm. longo, supra applanato) articulato, sparsim pellucide punctato, supra subtusque (ut in *Toddalia aculeata*, Pers., reliquisque *Toddaliæ* speciebus, non vero in *Teclea nobilis*, Del., vix recte a cl. Bentham et Hooker ad *Toddaliam* relata) glandulis pluricellularibus in epidermis foveolis nidulantibus (*Theophrastearum* more) ornato; flores (masculi tantum suppetebant) breviter pedicellatis, in racemos vel paniculas racemiformes parvas (2–3 centimetrales) axillares terminalesque dispositi; alabastra globosa (diametro 1·8 mm.); calyx parvus, patellaris, obsolete 4-lobus, lobis rotundatis vel late deltoideis; petala valvata, elliptica, vix punctata; stamina 8, sub margine disci inserta, 4 petalis alterna reliquis paullo majora, omnia fertilia (ut in *Toddalia schmidelioidi*, Baker, Journ. Linn. Soc. xx. 1883, p. 118); pistillum rudimentarium, tetragonum, pyramidatum, germine 4-loculari, loculis minimis effœtis, singulis sub glandula oleipara magna dorsali occultis, stigmate obsolete 4-lobo.

In Madagascaria ad "Fort Dauphin" legit Scott Elliot, 3087!

BURSERACEÆ.

CANARIUM OBTUSIFOLIUM, sp. n.

Arborea, ramis griseis puberulis obscure striatis, foliis imparipinnatis 3–4-jugis, foliolis obovatis obtusis petiolulatis glabris venis prominentibus, racemis elongatis, ♂ multifloris 1–3nis, ♀ paucifloris solitariis, calyce cupulare 3-dentato, petalis 3 ovatis apice incrassato-inflexis, staminibus 6 lateraliter dehiscentibus, ovario ovoideo hirsuto.

A shrub or small tree. The younger branches covered with scaly pubescence. Leaves 7–9-foliolate, rarely 5- or 3-foliolate, about 13–25 cm. long; leaflets coriaceous, unequal-sided, 4–7 cm. long and 2–3 cm. broad; petiolule rugose, 5–8 mm. Racemes, *male*, 20 cm. or more, bearing numerous contracted 2–4-flowered cymules with pedicels 2–3 mm. long; *female*, 3–8-flowered, with longer (1 cm.) pedicels. Calyx enlarged in fruit to about 1 cm. in diameter. Petals with inflexed margins, about 7 mm. long (in ♀ flower), ending in a reflex point. Filaments 3 mm.

Tree in woods, Fort Dauphin, 2933!

MELIACEÆ.

QUIVISIA GRANDIFOLIA, sp. n. (Plate II.)

Fruticosa, ramis glabris rugosis, foliis ovatis vel lanceolatis obtusis breviter petiolatis laxe et obtuse dentatis coriaceis glabris margine revoluto, floribus 1–3nis axillaribus breviter pedicellatis, calycis 5-partiti segmentis subtrigonis ligulatis subcarnosis sparse hirsutis, corollæ rubræ segmentis elongatis obtusis tenuiter hirsutis, tubo stamineo elongato apice breviter 10-fido, antheris 10 apice longe apiculatis, disco parvo, ovario villoso.

An erect robust shrub with grey branches. Leaves 4–8 cm. long and 1·5–2·5 cm. broad; petiole about 5 mm.; serrations 3–5 on each side, broad and obtuse; texture thick and leathery, with veins not at all prominent. Pedicels about 5 mm., with minute bracts and bracteoles at base. Calyx about 5 or 6 mm., with the segments curved outwards. Corolla shorter than the staminal tube, which is 4–6 cm. long. Prolongations of connective as long as the anthers.

Near Fort Dauphin, July, 3025!

TRICHILIA EMARGINATA, sp. n.

Arbor omnino glabra, foliis 3–5-foliolatis (rarius abortu 1-foliolatis) foliolis oblongis emarginatis vix petiolulatis, rhachide supra canaliculato vix marginato, cymis folia æquantibus vel paullo superantibus subcorymbosis longe pedunculatis, bracteis parvis cupularibus margine membranaceo, calycis parvi segmentis rotundatis, petalis orbicularibus sparse stellato-pilosis.

A glabrous tree with red corrugated bark; the younger branches covered with a thin white gummy secretion. Leaves 7–9 cm. long (sometimes by abortion much shorter); terminal leaflet 4–6 cm. long and 1·5–2·5 cm. broad; lateral leaflets much shorter. Flowers about 3 mm. long, subsessile. Filaments connate almost to the anthers.

In woods, Fort Dauphin, 2866!

Near *T. asterotricha*, Radlk., in Bremen Abh. viii. p. 383.

CELASTRINEÆ.

CELASTRUS (§ POLYCARDIA) BACCATUS, sp. n.

Arbor, ramis glabris, foliis petiolatis ovatis obtusis vel subacutis coriaceis glabris margine incrassato dentato vel subintegro, pedunculis axillaribus solitariis ad apicem flores numerosos sessiles quasi fasciculatos ferentibus quam petioli duplo longioribus, bracteis minutis ovatis ciliatis, sepalis parvis orbicularibus dorso hirsutis, petalis ovatis basi subcordatis, capsula subcarnosa ovata 1-loculari, ovulis pendulis 2 versus medium placentarum affixis basi ligulato-arillatis.

A tree with greyish or black bark. Leaves 5–9 cm. long and 2·5–4 cm. broad; petiole about 1 cm.; very thick and coriaceous, with the margin usually inconspicuously toothed. Peduncles 2–3 cm. long. Flowers about 5 mm. in diameter. Capsule about 1·5 cm. long and 1 cm. broad, to all appearance quite 1-locular, with 5 parietal placentæ and 2 distant pendulous seeds on each.

Woods, Fort Dauphin, 2608! 2609!

Very closely allied to *Polycardia libera*, O. Hoffm. (Sertum Madag. p. 12), but distinguished by the glabrous stems and pedicels and the very extraordinary fruit. The genus *Polycardia* can scarcely be maintained, and especially when the peduncles are absolutely free from the leaf, as in this species.

AMPELIDEÆ.

VITIS LENTICELLATA, *Baker*, var. nov. HIRSUTA; ramis haud lenticellatis ubique hirsutis, foliis hirsutis longe petiolatis, cymis subumbellatis.

Alluvial plains, Vaingaindrano, 2190!

VITIS (§ CISSUS) LEUCOPHLEA, sp. n.

Volubilis, ramis tetragonis albidis, junioribus sparse pilosis, cirrhis simplicibus oppositifoliis, foliis ovatis vel subcordatis (etiam subsagittatis) acutis remote dentatis margine revoluto, stipulis triangularibus basi rotundatis brunneis, cymis subumbellatis paucifloris, bracteis ovatis ciliatis basi saccatis, pedicellis pilosis, floribus 4-meris, calyce cupulare, staminibus quam petala brevioribus.

Bark leathery, rather glaucous; younger branches, petioles, and peduncles bearing a few scattered golden-brown hairs. Leaf somewhat fleshy, with 3–4 pairs of distant linear thickened teeth; leaf (excluding petiole, which is about 1 cm.) about 2·5–4 cm. long and from 1·5–2·5 cm. broad. Tendrils 8–10 cm. long. Racemes 2–3 cm. long, consisting of four or five subumbellate 4–10-flowered cymules; bracts about 2 mm. Flowers 2–3 mm. long. Anthers large, oblong.

Woods, Fort Dauphin, 2536!

Allied to *V. repens*, Wight & Arn. (*Cissus repens*, Lam.).

LEGUMINOSÆ.

PHASEOLUS (§ STROPHOSTYLES) DIFFUSUS, sp. n.

Herba volubilis, ramis glabris (vel junioribus sparse pilosis), foliis 3-foliolatis, stipulis supra basin affixis 5-nerviis sagittatis, foliolis lanceolatis basi rotundatis sæpius obtusis mucronulatis, stipellis linearibus petiolulos hirsutos æquantibus, pedunculis elongatis 2–3-floris, bracteolis linearibus calycem superantibus, ovario villoso, stylo complete spirali, legumine lineari villoso.

A climber with glabrous stems. Leaflets 3–4·5 cm. long and 1–2 cm. broad, when mature quite glabrous, densely reticulate-veined; petiolule 4-winged, very hairy; petiole 1–2 cm. long, channelled above, sparsely hairy. Flowers about 1·5 cm. long, yellow; calyx 4 mm. long. Vexillum with 2 callosities in front and 2 small lateral basal spurs on the claw. Pod (immature) 1·5 cm. long.

Near Fort Dauphin, 2366 ! 2849 !

Very similar to *Phaseolus minimus*, Roxb.

INDIGOFERA COMPRESSA, *Lam.* Open places, Fort Dauphin, 2525 !

Commerson only, in Herb. Mus. Par.

CROTALARIA XANTHOCLADA, *Boj.* Dry hills of Imerina, Antananarivo, 1811 !

My specimens seem to show that *C. tenuis*, Baker, is only a reduced form of this species.

CROTALARIA SENEGALENSIS, *Baill.* Open meadow-land, Fort Dauphin, 2472 !

New to Madagascar.

CROTALARIA LÆVIGATA, *Lam.* Open ground near Bévooy, 2288 !

(Another of Commerson's hitherto unique species.)

TEPHROSIA COMMERSONI, *S. Elliot*; syn. *Galega pumila*, Lam. Open places, Fort Dauphin, 2464 !

Previously only found by Commerson.

TEPHROSIA LEUCOCLADA, sp. n.

Suffrutex ramosissimus, ramis foliisque omnino dense appresseque argenteo-hirsutis, stipulis parvis linearibus, foliis 6–9-jugis, foliolis oblongis vel ellipticis obtusis haud mucronulatis, racemis terminalibus 6–∞-floris, floribus pedicellatis, calyce usque ad medium fisso, segmentis ovatis acutis, vexillo emarginato basi subcordato, stylo minute puberulo, apice ciliato, legumine recto remote appresseque hirsuto, seminibus 8.

A small much-branched shrublet; stem always hairy. Leaves 6–8 cm. long; rhachis furrowed above, densely white-hairy, and 3–4 cm. ($1\frac{1}{2}$ inches) long; petiole about 1·5 cm.; leaflets about 1–1·5 cm. long and 7 mm. broad, with the upper surface eventually becoming thinly hairy though never glabrous. Racemes up to 9 cm. long; pedicels about 3 mm.; bracts 1 mm. Calyx 4 mm. Vexillum about 7 mm. long and almost as broad; alæ 8 mm. long. Pods about 4 cm. long and about 5 mm. broad.

Very near *T. Apollinea*, DC., but distinguished by smaller and more numerous leaflets and the denser pubescence as well as other points.

Sandy dunes near sea, Fort Dauphin, 2297 !

Cassia brevifolia, *Lam.* Open sandy soil, Fort Dauphin, 2429! 2446!

Only known from specimens at Paris, Commerson.

Bauhinia Commersoni, *Decne.* Common near Fort Dauphin, 2419!

(Before only found by Commerson.)

Desmanthus paucifoliolatus, sp. n.

Fruticosus, ramis griseis glabris, foliis sæpissime 1-jugis, pinnis 1-jugis, foliolis obliquis subrhomboideis obtusis glabris dense et prominente reticulato-venosis, petiolis petiolulisque sulcatis, pedunculis brevibus paucifloris, bracteis linearibus ciliatis, calyce breviter 5-dentato, dentibus ciliatis, corollæ segmentis ovatis, staminibus 8–10, legumine recto ad basin attenuato marginibus coriaceis, seminibus obliquis.

Branches white, spreading, when young thinly hairy. Leaves usually short and very variable in the size of the leaflets (from 1·5–3 cm. long and 1–2 cm. broad); rhachis of pinnæ as long as petiole, about 5 mm. Corolla about 4 mm. long; calyx about half as long as corolla. Pod about 8 cm. long and nearly 1 cm. broad, glabrous, with numerous raised veins; seeds about 8, brown, glabrous, and shining.

Thickets on sandy soil, Fort Dauphin, 2850! 2587!

Albizzia zygioides, *Baill.* Woods, Fort Dauphin, 2659! (Only in Herb. Mus. Par.)

Calliandra alternans, *Benth.* Woods, Fort Dauphin, 2675!

Cadia Commersoniana, *Baill.* Woods, Fort Dauphin, 3013!

(Another species, hitherto found only by Commerson.)

Mimosa Helvilleana, *Baill.* Fort Dauphin, 2544!

Mimosa Psoralea, *Benth.* Fianarantsoa, 2060!

CRASSULACEÆ.

Kalanchoe (§ Kitchingia) verticillata, sp. n. (Plate III.)

Herba erecta, omnino glabra, foliis ternatis carnosis cylindraceis apice 3–5-dentatis, floribus terminalibus pendulis numerosis, calycis segmentis tubum æquantibus, corolla infundibulari coccinea, staminibus infra medium tubi insertis, antheris oblongis,

disci squamis cupularibus, carpellis 4–5, seminibus parvis nigris striatis.

An upright herb, 20–30 cm. in height. Leaves about 2–3 cm. long and 2 mm. in diameter, terete, fleshy, ending in 5 small teeth, 3 linear erect and 2 broad reflexed, with a gland in the centre. Flowers 2–5 cm. long on drooping pedicels about 6–8 cm. Calyx about 8 mm. Corolla scarlet, constricted above the base, with short (3 mm.) obtuse apiculate segments. Stamens 3 mm. shorter than the styles. Nectarial scales small, cupular. Carpels 4–5. Calyx and lower half of corolla persistent in fruit.

Sandy dunes, Fort Dauphin, 2983!

KALANCHOE BRACTEATA, sp. n.

Perennis, ramis dense velutino-tomentosis, foliis ovatis subacutis petiolatis carnosis albo-tomentosis, racemis terminalibus bracteatis, bracteis foliis subsimilaribus, calycis segmentis 4 brevibus triangularibus, corollæ segmentis parvis rotundatis apice calloso-mucronulatis quam tubus brevioribus, staminibus 8, disci squamis quadratis, carpellis 4.

About 1½ feet high. Branches when young obscurely four-sided. Leaves 2–3 cm. long (excluding petiole 5–7 mm.) and 1–1·5 cm. broad. Cymules 3- or many-flowered; pedicels under 1 cm.; bracts 1 cm. or more long. Calyx 4–5 mm., divided almost to base. Corolla about 1 cm. long, and 5 mm. broad at the base, narrowing slightly at the throat; segments with a fleshy mucro at the back near the tip. Anthers oblong, with connective sometimes apiculate.

Sandy dunes, Fort Dauphin, 2993!

COMBRETACEÆ.

COMBRETUM PURPUREA, *Vahl*, var. BRACTEATA, nov. var.

Erect and shrubby in habit. Leaves very large, obovate, coriaceous. Blade 9 cm. long and 5 cm. broad. Petiole 1–5 cm. Flowers in axils of small linear hairy bracts.

Open ground, Fort Dauphin, May, 2565!

RHIZOPHOREÆ.

MACARISIA EMARGINATA, sp. n.

Arbuscula, ramis corrugatis tenuiter hirsutis, foliis oppositis

obovatis obtusis vel sæpius emarginatis, petiolo costisque laxe tenuiterque pilosis cæteris glaberrimis, pedunculis axillaribus brevissimis 1–2-floris, bracteis minutis, sepalis triangularibus demum reflexis, staminibus 15 basi in cupulam breviter connatis, ovario subclavato vel oblongo obscure 10-sulcato dense velutino-tomentosis 5-loculari, loculis 1-ovulatis, seminibus superne late alatis.

A shrub with grey branches and thinly covered with hairs especially at the nodes. Leaves (excluding petiole about 5 mm.) 4–6 cm. long and about 2·5 cm. broad; margin cutinized, occasionally obscurely serrate, subrevolute. Peduncles 6–7 mm. long; pedicels very short. Sepals about 3 mm. Ovary about 1·5 cm. long and 1 cm. in diameter, spuriously 10-celled by intrusion of the septa. Seed 2 mm. long, with a broad wing 4–6 mm. long attached to upper part.

Woods near Fort Dauphin, 2747!

Anisophyllea fallax, sp. n.

Frutex, ramis junioribus dense sericeis demum glabratis, foliis ovatis acutis ad apicem callosis brevissime petiolatis 5-nerviis coriaceis margine revoluto, spicis axillaribus, bracteis linearibus, sepalis 4 triangularibus acutis obscure 5-nerviis, petalis laciniatis, laciniis filamenta cum antheris simulantibus, stylis 4 subulatis recurvis.

A shrub with erect spreading branches. Leaves when young rather densely covered with long scattered hairs, but becoming quite glabrous as well as thick and coriaceous; usually 4–7 cm. long and about 3·5 cm. broad; veins parallel (5–7), ending in a thickened glandular point. Spikes 4–5 cm. long, with rather numerous flowers each about 3 mm. in diameter. Sepals acute. Petals cut up into 5–10 laciniæ, each of which has exactly the appearance of a filament and ends in a globose white swelling resembling an anther. (This is probably a similar arrangement to that in *Parnassia palustris* for deceiving insects.)

Open ground near Fort Dauphin, 2811!

MYRTACEÆ.

Eugenia Jambolana, *Linn.*

Native name "Rohitra," a good timber tree. Fort Dauphin, 2554! 2398! New to Madagascar.

MELASTOMACEÆ.

(By Prof. A. Cogniaux.)

Osbeckia dionychoides, *Cogn.*, sp. n.

O. ramis foliisque supra brevissime denseque setulosis, foliis petiolatis ovato-oblongis acutiusculis basi rotundatis subtus brevissime denseque velutinis, 7-nerviis, nervis 2 intermediis basi distincte coalitis; paniculis paucifloris; floribus 4-meris, longiuscule pedicellatis, calyce subhemisphærico, ut videtur subtruncato adpresse longiuscule denseque setuloso, antheris oblongis, fructu exserto.

Rami robusti, obscure tetragoni. Petiolus robustiusculus, breviter denseque setulosus, 1–1·5 cm. longus. Folia rigida, 5–6 cm. longa, 2·5–3 cm. lata. Paniculæ 3 cm. longæ; pedicelli robusti dense adpresseque setulosi, 5–8 mm. longi. Calyx 5 mm. longus. Petala purpurea, late obovata, subretusa, brevissime ciliata, 1 cm. longa. Antheræ inappendiculatæ, 3 mm. longæ. Stylus gracilis, 1 cm. longus. Capsula globosa 4-costata, superne longiuscule denseque villosa, 8 mm. crassa. Semina $\frac{3}{4}$ mm. longa.

Near Vaingaindrano (East Coast), 2266!

Osbeckia Elliotii, *Cogn.*, sp. n. (Plate IV.)

O. ramis junioribus ad nodos brevissime ciliatis cæteris glaberrimis, foliis petiolatis oblongis breviter acuminatis basi acutiusculis vel subrotundatis trinerviis vel obscure 5-nerviis, supra tenuissime denseque albo-punctatis subtus ad nervos vix setulosis cæteris glabris, paniculis paucifloris, floribus 4-meris breviter pedicellatis, calyce paucisetuloso præcipue ad lobos, tubo subovoideo-campanulato, lobis anguste triangularibus obtusis, tubo paullo longioribus, antheris oblongo-linearibus obtusis.

Rami satis graciles, obscure tetragoni. Petiolus gracilis glaber, 1–1·5 cm. longus. Folia rigidiuscula supra intense viridia subtus pallida, 5–7 cm. longa, 1·5–2 cm. lata. Paniculæ foliosæ 5–7 cm. longæ; pedicelli glabri, 3–8 mm. longi. Calycis tubus pallide viridis, 5 mm. longus; lobi distincte articulati, 6–7 mm. longi. Petala rosea, obovata, truncata vel subretusa, breviter ciliata, 15–17 mm. longa. Antheræ aurantiacæ, 5–6 mm. longæ, loculis leviter undulatis. Stylus filiformis, 1·5 cm. longus. Capsula subglobosa, apice breviter setulosa cæteris glabra, 5–6 mm. crassa.

Near Fort Dauphin in woods, 2488! Vaingaindrano, 2251!

Dichœtanthera grandifolia, *Cogn.*, sp. n.

Ramis obtuse tetragonis, ad nodos annulato-setosis cæteris

glaberrimis lævibusque; foliis magnis, ovato-oblongis, acutis, basi subrotundatis, 5-nerviis, supra glabris vel leviter furfuraceis, subtus ad nervos longe sparse adpresseque setosis cæteris vix setulosis; paniculis amplis, multifloris; floribus 4-meris; calyce glabro, tubo campanulato-urceolato, lobis late rotundatis, tubo multo brevioribus.

Rami robusti, elongati, simplices. Petiolus robustiusculus, sparsissime longeque setosus, 3 cm. longus. Folia rigida, 13–15 cm. longa, 5½–6½ cm. lata; nervis robustis, supra profunde impressis, subtus nervulisque valde prominentibus; nervulis numerosis. Paniculæ ut videtur late pyramidatæ, ramis patulis, valde ramulosis; pedicelli 3–4 mm. longi. Calycis tubus 5 mm. longus latusque, demum 8-costatus, apice leviter constrictus; lobi patuli, coriacei, 1½ mm. longi. Petala rubra, late suborbicularia, 7–8 mm. lata. Antheræ tortuosæ, 5 mm. longæ. Stylus filiformis, 14–15 mm. longus. Capsula subglobosa, tetragona, vertice paucisetosa, 5 mm. crassa.

Woods near Fort Dauphin, 3040!

MEDINILLA ELONGATA, *Cogn.*, sp. n.

Glaberrima vel in juventute vix furfuracea; ramis obtuse tetragonis; foliis oppositis, longe petiolatis, oblongis, breviter acuminatis, basi rotundatis, subtiliter remoteque denticulatis, obscure 5-nerviis; paniculis terminalibus, elongatis, paucifloris; floribus 4-meris, ebracteatis; calyce subhemisphærico, limbo obscure 4-lobato; petalis apice rotundatis.

Rami robusti. Petiolus satis gracilis, angulato-sulcatus, supra apice breviter denseque pilosus, 5–9 cm. longus. Folia submembranacea, supra læte viridia, subtus satis pallidiora, 9–14 cm. longa, 2½–4 cm. lata. Paniculæ ut videtur pendulæ, augustæ, 2½–3 dm. longæ; pedunculus communis gracilis, teres, inferne longe simplex; rami breves patuli; pedicelli 2–5 mm. longi. Calyx pallide viridis, 5 mm. latus. Petala pallide rosea, late ovata, 4 mm. longa. Antheræ lineari-subulatæ, 3 mm. longæ, postice obscure calcaratæ. Stylus apice attenuatus, 4 mm. longus.

Woods near Fort Dauphin, 2697!

MEMECYLON TETRAPTERUM, *Cogn.*, sp. n.

Fere glaberrimum; ramis tetrapteris, ad nodos breviter annulato-setosis; foliis subsessilibus, ovatis vel obovatis, obtusis vel interdum retusis, basi subacutis, obscure penninerviis; cymis

axillaribus, brevissimis, paucifloris; calyce subhemisphærico, limbo minute 4-denticulato; petalis triangularibus, longe acuminatis.

Rami graciles, fuscescentes. Folia patula, rigidiuscula, supra nitidula, 14–18 mm. longa, 9–12 mm. lata. Cymæ 4–5 mm. longæ, ad nodos brevissime setulosæ; pedicelli vix 1 mm. longi. Calyx atro-viridis, 1½–2 mm. latus. Petala 2 mm. longa. Antheræ rostratæ, ecalcaratæ, 1½ mm. longæ. Stylus capillaris, demum 4–5 mm. longus.

Alluvial plains of Vaingaindrano, 2203 et 2252!

CUCURBITACEÆ.

(By Prof. A. Cogniaux.)

Cucumis parvifolius, *Cogn.*, sp. n.

Annuus; caule procumbente, cirrhoso, setulis brevissimis subreflexis dense vestito demum scabro; foliis parvis, viridi-cinereis, submembranaceis, utrinque longiuscule denseque setulosis, late ovato-cordatis, subintegris vel leviter trilobatis, lobis late triangularibus, acutis, intermedio multo majore, sinubus rotundatis; pedunculo femineo brevi, satis gracili; ovario ovoideo, breviuscule denseque hirsuto; fructu late ovoideo, aculeis crassis brevibus dense vestito, toto densissime breviterque setuloso.

Caulis gracilis, brevis, subsimplex, sulcatus, cinereus. Petiolus gracilis, striatus, breviter denseque hirsutus, 1–2½ cm. longus. Folia 1½–2½ cm. longa lataque, margine minute denticulata, basi leviter emarginata, pedato-5-nervia. Cirrhi subfiliformes, breves, sulcati, brevissime hirtelli. Flores masculi a nobis non visi. Pedunculus femineus 2–4 mm. longus, densiuscule hispidus. Fructus cinereus, 1½ cm. longus, 12 mm. crassus. Semina pallida, obovato-oblonga, valde compressa, obscure marginata, 4½–5 mm. longa, 2 mm. lata.—Aff. *C. subsericeo*, Hook. f.; Cogn. in DC. Monogr. Phan. iii. 506.

Amongst grass near Lake Itasy (Interior), 1947!

Melothria (§ Eumelothria) Elliotiana, *Cogn.*, sp. n.

Monoica, glaberrima; foliis ovato-cordatis subdeltoideis, integris, supra tenuissime denseque punctato-scabriusculis, subtus glaberrimis; cirrhis simplicibus; racemis masculis paucifloris, petiolo paullo brevioribus; calyce late campanulato; antheris subexsertis, glabris, non appendiculatis; fructu globoso; seminibus lævibus tenuiter marginatis.

Rami gracillimi, sulcati, læves. Petiolus gracilis, striatus, 2·5–3 cm. longus. Folia tenuiter membranacea, intense viridia, breviter obtuseque acuminata et mucronulata, 5–6 cm. longa et fere totidem lata, margine undulato-denticulata; sinus basilaris late rotundatus, 1 cm. profundus. Cirrhi graciles, breviusculi, sulcati. Pedunculus communis masculus filiformis, striatus, 2–2·5 cm. longus, apice 4–6-florus; pedicelli 2–4 mm. longi. Calyx glaber, 1·5 mm. longus, 2 mm. latus. Corolla glabrata, segmentis erecto-patulis, ovatis, obtusis, 2 mm. longis. Staminum filamenta 1 mm. longa; antheræ suborbiculares, $\frac{3}{4}$ mm. latæ. Pedunculus fructiferus, filiformis, 1·5 cm. longus. Fructus lævis, 6 mm. crassus.—Aff. *M. marginatæ*, Cogn. in DC. Monogr. Phan. iii. 593.

Melothria (§ Solena) polycarpa, *Cogn.*, sp. n.

Monoica, fere glaberrima; foliis membranaceis, ovato-cordatis, angulatis vel obscure trilobatis, supra tenuissime albo-punctatis scabrisque, subtus glabris sublævibusque; floribus masculis femineisque ad apicem pedunculi communis subumbellatis; calyce glabro; fructu globoso creberrime subtiliterque foveolato; seminibus parvis valde compressis, distincte marginatis.

Rami gracillimi, sulcati, glaberrimi, ramulosi. Petiolus gracilis, striatus, glaber 1–3 cm. longus. Folia intense viridia, 3–4·5 cm. longa lataque, apice acutiuscula et mucronulata, margine undulato-denticulata; sinus basilaris late rotundatus, ·5–1 cm. profundus. Cirrhi capillares, elongati, glabri. Pedunculi communes masculi femineique capillares, sulcati, 1–2 cm longi, apice 3–5-flori; pedicelli 2–3 mm. longi. Calycis tubus campanulatus, 1·5 mm. longus; dentes brevissimi. Corollæ segmenta ovata acutiuscula, leviter furfuraceo-puberula, $1\frac{1}{2}$ mm. longa. Antheræ ovatæ, dense papillosæ, $\frac{3}{4}$ mm. longæ. Fructus glaber, pallide viridis, 6–7 mm. crassus. Semina albida, lævia, anguste ovata, 3–$3\frac{1}{2}$ mm. longa, 2 mm. lata.—Aff. *M. perpusillæ*, Cogn. l. c. 607.

Thickets, Fort Dauphin, 2316!

SAMYDEÆ.

Calantica lucida, sp. n. (Plate V.)

Arbuscula, ramis rugosis, junioribus hirsutis, foliis lanceolatis vel oblanceolatis obtusis glaberrimis breviter petiolatis, cymis axillaribus subumbellatis 20-floris dense albo-hirsutis, sepalis ovatis glandula magna sessile auctis, petalis linearibus, antheris basi villis 3–4 ornatis extrorsum dehiscentibus, ovario villoso.

A shrub with wrinkled branches densely hairy when young. Leaves glabrous and glossy above, reddish brown on the lower surface; (excluding the petiole, which is about 5 mm.) usually 3–4·5 cm. long and 1–1·5 cm. broad, occasionally obscurely toothed. Peduncle 5 mm.; pedicels about as long. Sepals and petals 3–4 mm. densely hairy. Sepaline gland wrinkled, sessile. Ovary and receptacle very hairy.

Woods, Fort Dauphin, 2834!

HOMALIUM (§ MYRIANTHEIA) BREVIPEDUNCULATUM, sp. n.

Arbor, ramis griseis minute hirsutis, foliis oppositis vel alternis obovatis obtusis vel emarginatis reflexis coriaceis, subtus supra venas puberulis cæteris glabris coriaceis, pedunculis quam folia brevioribus tetragonis velutino-tomentosis paucifloris, floribus 5-meris subsessilibus, calycis segmentis quam tubus longioribus apice obtusis, petalis spathulatis margine ciliato, staminibus sæpius 15, glandulis subsessilibus globosis rugosis glabris, stylis 3–4.

A tree with grey bark. Leaves (excluding petiole about 5 mm.) 6·5–8 cm. long and 3·5–6 cm. broad. Peduncle 2–3 cm. long; flowers chiefly terminal. Calyx obconic, externally densely velvety pubescent; segments 5–6 mm. long. Glands about 1 mm. in diameter. Stamens shorter than the petals. Ovary covered with long stiff hairs. Near *H. nobile*, Baill.

Woods, Fort Dauphin on sandy soil, 2600!

HOMALIUM (§ MYRIANTHEIA) FASCICULATUM, sp. n.

Arbor, ramis juventute obscure puberulis demum glabratis, foliis oppositis rarius alternis obovatis emarginatis subtus supra venulos pubescentibus cæteris glabris coriaceis, margine revoluto rarius serrato, pedunculis axillaribus quam folia longioribus dense hirsutis, floribus 1–3nis brevissime pedicellatis, bracteis ovatis, calycis tubo turbinato quam segmenta multo breviore, petalis sepala paullo superantibus spathulatis, glandulis reniformibus hirsutis brevissime pedunculatis.

A shrub or small tree with grey branches. Leaves crowded, varying from ovate to broadly obovate; blade 4·5–6·5 cm. long and 2–3·5 cm. broad, petiole 5–7 mm. long. Peduncles 5–7 cm. long, with usually about 6 irregular whorls of flowers. Bracts 5 mm. Flowers about 1 cm. in length and the same in diameter. Sepals about 6 mm. Filaments hairy, anther-loculi parallel,

attached by the apex. Glands free from sepals and about 2 mm. long. Ovary wholly superior. Near *H. nobile*, Baill., and preceding sp.

Woods on white sandy soil, Fort Dauphin, 2617! 2639!

Homalium (§ Myriantheia) urceolatum, sp. n.

Arbuscula, ramis brunneis striatis glabris, foliis lanceolatis vel oblanceolatis acutis vel obtusis serratis margine revoluto, pedunculis quam folia longioribus velutino-tomentosis, floribus 4-meris solitariis dissitis breviter pedicellatis, bracteis minutis, bracteolis pedicello adnatis, calycis tubo turbinato externe puberulo quam segmenta paullo longiore, petalis spathulatis, staminibus sæpius 12 petala æquantibus, glandulis superne concavis carnosis pedunculatis lateraliter glandulis minimis auctis.

A tree or shrub with brown glabrous branches. Leaves with about 9 pairs of blunt serrations, each of which has a depressed gland on the lower surface below the tip; leaves, exclusive of petiole, 5–7 cm. long and 2–3 cm. broad; petiole 5 mm. Peduncles 6–9 cm.; pedicels about 2 mm. long. Petals about 3 mm. Calyx-tube 3 mm. Styles 3. Ovary very hairy; ovules numerous.

Woods, Fort Dauphin, 2662!

Homalium (§ Myriantheia) cymosulum, sp. n. (Plate VI.)

Arbuscula, ramis corrugatis griseis glabris, foliis sæpius alternis oblongis obtusis vel acutis breviter petiolatis serratis, pedunculis quam folia multo longioribus velutino-tomentosis, cymulis numerosis 1–4-floris, bracteis parvis triangularibus, bracteolis ovatis pedicellos æquantibus, calycis tubo quam segmenta breviore, petalis spathulatis quam sepala longioribus, staminibus petala æquantibus sæpius 15, glandulis pedunculatis capitatis hirsutis, stylis 3.

Branches grey and almost glabrous; leaves 3·5–6·5 cm. long and 2–3 cm. broad exclusive of petiole (which is about 4 mm.); serrations blunt with a pitted gland on the lower surface. Peduncles 9 cm. long, bearing numerous contracted cymules; bracts triangular, 1–2 mm., glabrous within; bracteoles as long as but free from the pedicels (2–3 mm.). Calyx-segments about 4 mm., with glands nearly 2 mm. in height. Stamens varying from 1–3 opposite each petal in the same flower. Very near *H. fasciculatum*, but easily distinguished by the inflorescence, bracts, and glands.

Woods on sandy soil, Fort Dauphin, 3037!

HOMALIUM (§ MYRIANTHEIA) LANCEOLATUM, sp. n.

Arbuscula, ramis saltem junioribus tetragonis, foliis oppositis sæpius per paria aggregatis 4nis lanceolatis acutis basi subcordatis serratis glabris, pedunculis quam folia brevioribus dense hirsutis, floribus subsessilibus 5-meris, calyce fere ad basin diviso omnino pubescente, calycis segmentis oblongis obtusis, petalis ovatis sepala superantibus, staminibus 15 petalis dimidio brevioribus, filamentis hirsutis, glandulis breviter pedunculatis, stylis 3–4.

A shrub or small tree with brown bark. Leaves bluntly serrate, with a pit-like glandular depression under the tip of the teeth; usually 5–9·5 cm. long and 2–2·5 cm. broad; petiole 3–4 mm. Peduncles about 4 cm., with flowers only in the upper half. Flowers 6–7 mm. in diameter; bracts ovate, less than 2 mm.; bracteoles 3 mm. longer than the pedicels. Distinguished by the peculiar cordate base of the leaf.

In woods, Fort Dauphin, 3056 !

HOMALIUM (§ NISA) INVOLUCRATUM, *Baill.*, var. LUCIDA, nov. var.; leaves obtuse (5–8 cm. long and 2·5 cm. broad), glossy glandular above, paler below, with markedly revolute edges (thus differing considerably from the ordinary type of the species).

In woods, sandy soil, Fort Dauphin, 2304 !

HOMALIUM (§ NISA) BAILLONI, sp. n.

Arbor, ramis corrugatis glabris, foliis oblongis vel ovatis obtusis vel cuspidatis coriaceis glaberrimis lucidis, pedunculis axillaribus quam folia longioribus, floribus candidis 1–3nis sessilibus, bracteis cupularibus, calycis tubo externe glanduloso 8-sulcato quam segmenta longiore, petalis obovatis obtusis membranaceis sepala multo superantibus, staminibus 4–5 brevibus, glandulis parvis, stylis 4–5, ovario sub 1-loculari.

A tree with glabrous, irregularly furrowed branches. Leaves dark and glossy above, lighter in colour below, prominently veined on both surfaces; the margin entire, or with a minute glandular sinus at exit of the lateral nerves; blade 8·5–12 cm. long and 5·5–6·5 cm. broad; petiole 1·5–2·5 cm. long. Peduncles zigzagged, 8–10 cm. long. Flowers sessile, 4–5-merous. Calyx-tube about 3–4 mm. long, with short (2–3 mm.) blunt rounded teeth. Petals 6–7 mm. long, pure white, with raised veins.

Woods, white sand, Fort Dauphin, 2853 !

HOMALIUM (§ BLACKWELLIA) INTEGRIFOLIUM, *S. Elliot.* (Syn. *Blackwellia integrifolia*, Lam., *ex descript.*)

Both the figure and description in Lamarck's Encycl. (tab. 412) are very vague, and I have been unable to find the specimen in Lamarck's Herbarium at Paris. It is distinguished from the next species by its pedicellate flowers.

HOMALIUM (§ BLACKWELLIA) LUCIDUM, sp. n.

Arbor, ramis pallidis striatis, foliis variis lanceolatis ovatis vel obovatis acutis vel obtusis (etiam emarginatis) lucidis margine serrato, pedunculis axillaribus simplicibus elongatis, floribus numerosis subsessilibus 6–8-meris, calycis tubo turbinato striato pubescente, segmentis minutis rotundatis, petalis ligulatis obtusis ciliatis fructu persistentibus, filamentis brevibus, glandulis sessilibus hemisphæricis hirsutis, ovario 1-loculari, stylis 3.

A tree with light-coloured bark and dark-brown leaves, smooth and glossy above, paler below; veins prominent on both surfaces; blade 6–8 cm. long and 2–3·5 cm. broad; petiole about 1 cm. Peduncles numerous, erect, 7–10 cm. long, and densely covered with flowers. Flowers about 5 mm. in diameter, with a small conical calyx-tube and minute (1 mm.) sepals; the petals reflex and persistent in fruit; anthers bilobed; ovary apparently entirely 1-locular.

Woods, Fort Dauphin, 2661!

PASSIFLOREÆ.

PHYSENA MADAGASCARIENSIS, *Thou.*, var. LONGIFOLIA; foliis oblongis coriaceis (8–12 cm. longis et 2–3 cm. latis); sepalis 5–8, 1-nerviis non maculatis, staminibus 10–16.

Fort Dauphin, 2741!

FICOIDEÆ.

MOLLUGO DECANDRA, sp. n.

Frutex, ramis erectis rigidis lignosis obscure tetragonis, foliis alternis crassis obovatis vel spathulatis ad basin attenuatis glabris, sepalis 5 oblongis, petalis 0, staminibus 10 ima basi subconnatis, capsula 3-loculari, pauci-ovulata, seminibus nigris reniformibus tuberculatis.

A shrub 2–3 feet high, with stiff *Lycium*-like branches. Leaves in alternate fascicles, usually 3 together, very variable in shape

and size; usually 1–3 cm. long and from 3–6 mm. broad. Stamens 10, swollen towards the base. Capsule oblong, as long as the sepals; styles free to the base.

Sea-shore near Fort Dauphin, April, 2481!

The extraordinary habit and 10 stamens separate this species from all others, and it is with some doubt that I have included it under *Mollugo*. It has a distinct affinity to *Macarthuria* and *Telephium*, but could not be placed under these genera, so that, as it is distinctly related to the following species, which has also 10 stamens, I have refrained from making a new genus.

Mollugo cæspitosa, sp. n. (Plate VII.)

Perennis, radice lignoso, foliis rosulatis spathulatis obtusis vel emarginatis ad basin amplexicaule attenuatis, pedunculis minute puberulis, cymis congestis subumbellatis, bracteis membranaceis ovatis acutis, sepalis 5 oblongis obtusis, petalis 0, staminibus 10–15, seminibus paucis minute tuberculatis strophiolatis.

A small woody perennial. Leaves 2·5–3·5 cm. long and 1–1·5 cm. broad (at the base 3 mm. broad). Peduncles 2 or more, 3–5 cm. long, ending in a many bracteate umbel, which consists apparently of contracted pseudodichotomous cymes. Bracts small, white, one-nerved. Sepals about 3 mm. long. Capsule as long as the sepals.

Allied to the common *M. nudicaulis*, Linn.

From arid sandy country of the Antandroi, S.E. of Fort Dauphin, June–July, 2978!

ARALIACEÆ.

Panax ornifolius, *Baker* *, var. pauciflora; secondary peduncles 2–3-flowered; pedicels shorter (less than $\frac{1}{4}$ inch); leaves more coriaceous and reflex; mature fruit pentagonal.

Woods, Fort Dauphin, June, 2837!

RUBIACEÆ.

Webera saxatilis, sp. n. (*Genipa*, sensu Baill.)

Frutex, ramis hirsutis subtetragonis, foliis oblongis vel ovatis supra glabratis subtus dense sericeo-villosis margine revoluto,

* The "cupule" (*vide* Baker, in Journ. Linn. Soc. Bot. xx. 155) seems like the united bracts of an umbel which has been reduced to a single sessile flower. The flower is articulated *above the cupule*, as one would expect if this were the case.

stipulis in limbum latum ovatum acuminatum connatis, floribus numerosis quasi terminalibus breviter pedicellatis corymbosis, bracteis linearibus hirsutis, calycis segmentis tubum æquantibus, corollæ tubo elongato sericeo-villoso, lobis rotundatis, ovarii loculis 4-ovulatis, seminibus peltate affixis, bacca globosa nigra tenuiter hirsuta.

A much-branched shrub with grey bark. Leaves 1·5–2 cm. long (exclusive of the petiole about 3 mm.) and 7 mm. to 1·5 cm. broad, black and glabrous above, very densely hairy below. Calyx-limb 2–3 mm. Corolla 7–8 mm. Berry 6 mm. in diameter, with 2 loculi, each with four seeds affixed together—2 erect and 2 pendulous.

Open ground, Fort Dauphin, 2683 ! 2885 !

Carphalea angulata, *Baill.*

Only in herb. Mus. Par.

Fort Dauphin, 3002 ! 2563 !

Flagenium triflorum, *Baill.* (Syn. *Triosteum triflorum*, Vahl.)

Only known in herb. Mus. Par.

Fort Dauphin, 2749 !

COMPOSITÆ.

Vernonia sublutea, sp. n.

Frutex, ramis divaricatis albo-tomentosis, foliis oblongis obtusis supra viridibus glabris subtus dense albo-tomentosis, capitulis solitariis vel 1–3nis terminalibus 10-floris, involucri bracteis 4–5-seriatis ovatis obtusis rigidis margine ciliato, corollis subluteis, achæniis hispidis 5-costatis, pappi setis scabridis paucis, exterioribus brevibus.

A low branching shrub with branchlets white and woolly when young, and marked by raised ridges corresponding to the leaf-bases. Leaves, excluding petiole, 1–2 cm. long and 5–7 mm. broad; petiole 2–3 mm. Peduncles less than 1 cm.; involucre about 6 mm. long, with obtuse concave bracts. Corolla to all appearance bright yellow. Pappus of about 30 scabrous hairs; the outer pappus of short bristles.

Open sandy dunes, Fort Dauphin, 2552 ! 2736 !

Vernonia (§ Strobocalyx) Bailloni, sp. n.

Arbuscula, ramis striatis fulvo-hirsutis, foliis elongatis lanceo-

latis acutis basi cuneatis subamplexicaulibus supra glabris subtus purpureis remote hirsutis, cymis axillaribus dichotomiis hirsutis, capitulis ovoideis 2–3-floris, involucri bracteis 5-seriatis ovatis margine ciliato, achæniis 3-quetris, pappi setis copiosis scabridis.

Branches at first covered with shaggy indument, but finally becoming almost glabrous. Leaves unequal-sided, narrowed to the petiole and amplexicaul at base, slightly revolute at margin, usually 15 cm. long and about 4 cm. broad. Cymes covered with shaggy brown hairs; peduncles about 6 cm. long. Involucre about 7 mm.; the scales bearing a dark green mark at the tip and ciliate at the margin. Pappus double; the outer row about half as long as the inner.

Forest, Fort Dauphin, 2252!

VERNONIA (§ STROBOCALYX) ANTANOSSI, sp. n.

Arborea, ramis dense albo-lanatis, foliis oblanceolatis acutis subacuminatis supra viridibus subtus albo-tomentosis, capitulis 3 magnis globosis, involucri bracteis ovatis acutis rigidis dorso lanatis apice ciliatis, receptaculo minute fibrillato, corollæ elongatæ lobis apice corneis, achæniis longis striatis, pappi setis copiosis.

Leaves 10–18 cm. long and 5–7 cm. broad, cuneate at base, subglabrous and reticulately veined above, covered on lower surface with dense white tomentum. Capitula 1·5 cm. long and almost as broad, ∞-flowered. Involucre-scales many-seriate; the outer short and woolly, the inner gradually larger and more glabrous; the innermost cartilaginous and narrow. Corolla rather long, with the lobes ending in acute cartilaginous tips. Achenes 4–5 mm. long.

Allied to *V. rhaponticoides*, Baker, but easily distinguished by the larger leaves and smaller capitula.

Woods near Fort Dauphin, 2660!

VERNONIA (§ STROBOCALYX) FARADIFANI, sp. n.

Arborea, ramis dense albo-lanatis, foliis oblanceolatis acutis utrinque tomentosis ad basin attenuatis, capitulis corymbosis numerosis 6-floris subcylindraceis, involucri bracteis 3–5-seriatis ovatis dorso lanatis, achæniis striatis, pappi setis paucis (15) scabridis.

Branches marked by 3 raised lines corresponding to the leaf-bases. Leaves 6–10 cm. long and 2–3 cm. broad. Corymbs

terminal; involucre-scales very woolly and ciliate at the tip. Corolla about 1 cm. long, with rather long lobes. Pappus of about 15 scabrous hairs, with an exterior row $\frac{1}{4}$ their length.

Allied to *V. Baroni*, Baker.

Bévooy, Fort Dauphin, 2287!

NIDORELLA LIGULATA, sp. n.

Frutescens, ramis striatis hirsutis, foliis ovatis acutis dentatis utrinque scabrido-pilosis, pedunculis brevibus lanatis, involucri campanulati bracteis sub 3-seriatis, exterioribus linearibus, interioribus oblongis obtusis dorso dense ciliatis, receptaculo foveolato, corollæ ♀ ligulis brevibus 2-dentatis, achæniis hispidis basi areolatis, pappi setis numerosis.

Leaves somewhat cuneate at base, coarsely dentate (the teeth callous and glandular); leaves 3–6 cm. long and 2–3 cm. broad. Peduncles short, 2–3 together, densely covered with white hairs. Capitula 1·5 cm. in diameter; outer bracts linear, inner broader, densely white-hairy on the back. Ligule of female flower 3–4 mm. long. Pappus of thin, rather numerous hairs; achenes with a white cupular areola.

Woods, Fort Dauphin, 2698! also 3005!

APODOCEPHALA MINOR, sp. n.

Frutex, ramis striatis hirsutis, foliis ovatis subacutis basi rotundatis coriaceis utrinque scabrido-villosis, capitulis corymbosis 1-floris, corollæ tubo glanduloso-hirsuto, involucri bracteis 7–8, exterioribus parvis lanatis, interioribus gradatim majoribus, intimo magno margine circa florem inflexo, achæniis nigris hirsutis annulo cartilagineo coronatis.

An erect shrub with striate branches covered with scattered brownish hairs. Leaves rounded or subcordate at base, hairy on both surfaces, but especially on the prominent veins below; blade about 5–9 cm. long and 3–5 cm. broad, with a petiole about 4 cm. Panicles very dense; capitula in groups of 3–4; bracteoles 2, linear, woolly; outer bracts woolly, inner becoming gradually larger and more glabrous, the innermost with the edges bent in so as to completely surround the solitary flower. Corolla about 4 mm. long. Achenes black and hirsute, when mature about 4 mm. long.

This species differs from *A. pauciflora*, Baker, by the solitary flower in each capitulum and the very peculiar involucre.

Woods near Fort Dauphin, 3014! also 2527!

HELICHRYSUM (§ LEPICLINE) FARADIFANI, sp. n.

Fruticosa, ramis erectis glanduloso-scabridis, foliis lanceolatis sessilibus apice calloso-mucronulatis subtus tomentosis margine valde revoluto, capitulis campanulatis 9–12-floris, involucri bracteis ovatis obtusis candidis, fibrillis acutis rigidis, achæniis villosis, pappi setis rigidis albidis haud copiosis.

An erect branching shrub ($1\frac{1}{2}$ feet high) with leaves amplexicaul, covered with scattered hairs on upper surface and below with dense matted tomentum. Capitula about 5 mm. in length and the same in diameter. Involucre scales oblong or more usually ovate (sometimes almost acute), the midrib thickened below. Scales of receptacle about half as long as the involucre. Corolla yellow, shorter than the involucre; achenes small.

Open country, on sandy soil, Fort Dauphin, 2864!

HELICHRYSUM (§ EUHELICHRYSUM) ANTANDROI, sp. n.

Perenne, ramis prostratis cæspitosis dense albo-lanatis, foliis obovatis vel spathulatis ad basin attenuatis amplexicaulibus dense argenteo-tomentosis, capitulis sessilibus (circa) 40-floris, involucri bracteis 4–5-seriatis aureo-brunneis nitidis ovatis acutis basi incrassatis quasi unguiculatis, pappi setis paucis scabridis.

A low tufted perennial, 6–8 cm. in height. Leaves covered with dense silvery tomentum, 2–3 cm. long and 1–1·5 cm. broad. Capitula 3–4 mm. long. Involucre-scales with a short, thick, and curved claw expanded into an ovate golden-brown limb about 3 mm. long and 1 mm. broad. Pappus not mature.

Arid deserts of Antandroi country, south-east of Fort Dauphin, 2980!

SENECIO EMIRNENSIS, *DC.*, var. LANCEOLATA, *S. Elliot.* Open places, Ankaratra Mountains, 2091!

SENECIO VAINGAINDRANI, sp. n.

Frutex, ramis striatis araneoso-albidis, foliis elongatis lanceolatis acutis supra demum glabratis subtus dense albo-lanatis margine revoluto, panicula corymbosa, capitulis numerosis 20-floris, involucri bracteis ovatis acutis apice glandulosis, radii floribus ligulatis purpureis, achæniis striatis, pappi setis scabris haud copiosis.

An erect shrubby plant with the leaves crowded at the ends of the branches. Leaves about 7–10 cm. long and 1–2·5 cm. broad. Panicle corymbose; bracts small and linear; those of the involucre about 5 mm. long, slightly hairy and glandular at the tip; the inner with broad membranous margins; calycle of several

cobwebby bracteoles. Ray short and broad; corolla slightly longer than the involucre.

Marshy meadows, Angalampena (Interior), 2136!

Senecio (§ Annui) Bakeri, sp. n.

Herba sæpius prostrata glabra, foliis carnosis oblanceolatis vel spathulatis dentatis in petiolum longum attenuatis, capitulis laxe corymbosis, involucri bracteis 15–20 acutis oblongis, margine membranaceo albido, radii floribus 8 breviter ligulatis flavis, achæniis hirsutis, pappi setis copiosis flexuosis albidis.

A rather variable herbaceous plant: when growing near the sea the leaves are very crowded, thick, and fleshy; when growing inland, membranous and distant. Leaves semiamplexicaul, from oblanceolate to spathulate, usually obscurely serrate, from 2–6 cm. long and 1–1·5 cm. broad. Capitula 2–4 together, subcorymbose, more than 20-flowered, and about 5 mm. long. Calycle of numerous small bracteoles; bracts acute, with a broad white membranous margin. Achenes with a thick white cartilaginous ring at insertion of the pappus.

Allied to *S. Boutoni*, Balf. f., of Rodriguez, and *S. rhodanthus*, Baker.

Near the sea and shady places, Fort Dauphin, 2307! 2955!

Senecio (§ Kleinoidea) Antandroi, sp. n.

Perennis, foliis teretibus carnosis ad apices acutis callosis, capitulis 6–8 laxe corymbosis 15–20-floris, bracteolis parvis linearibus, involucri bracteis 6–8 ad apicem hirsutis obscure costatis margine albido membranaceo, floribus radii 2 (vel pluribus ?) involucrum paullo superantibus, corollæ tubo basi corneo styli basin tumidum includente, achæniis glabris, pappi setis copiosis.

A glabrous shrub with cylindrical fleshy leaves about 3 cm. long and 3 mm. in diameter. Peduncle 10–11 cm. long, with pedicels 1–3 cm. long, subtended by small (4 mm.) linear bracts. Involucre-bracts about 1·2 cm. long, with a tuft of minute hairs at the tip. Rays short; the basal 2 mm. of the corolla-tube cartilaginous, enclosing a nectarial swelling at the base of the style. Achenes quite glabrous.

Arid country of Antandroi to the south of Fort Dauphin, 2977!

Lactuca Welwitschii, sp. n.

Perennis, radice lignoso, foliis rosulatis obovatis obtusis supra glabris subtus albidis breviter petiolatis margine denticulato,

pedunculis elongatis subcorymbosis paucifloris, involucro basi 4-bracteolato, involucri bracteis 4 linearibus acutis glabris margine membranaceo, achæniis striatis glabris.

Root long and woody, about 7 mm. in diameter. Leaves crowded together, minutely dotted on lower surface, about 5–7 cm. long and 2–3 cm. broad, denticulate along the margin; denticles about 1 mm. high. Scape $1\frac{1}{2}$ feet, few-flowered. Bracteoles of calycle ovate-cordate (2–3 mm.); bracts of involucre 1·5 cm. long, with a broad membranous margin. Achenes 6 mm., marked by numerous scabrous ribs. Pappus abundant.

Angola, *Welwitsch* 3662! Sandy places, Fort Dauphin, *Scott Elliot* 2712!

SAPOTACEÆ.

SIDEROXYLON BAKERI, sp. n.

Fruticosum, ramulis pallidis striatis, foliis oblanceolatis in petiolum gradatim attenuatis glabris margine revoluto, calycis segmentis 5 ovatis basi subcordatis corollæ tubo segmenta æquante, staminibus 5 extrorsum dehiscentibus, staminodiis 5 ovatis hirsutis circa stylum conniventibus, stylo exserto, ovario hirsuto 5-loculari, loculis 1-ovulatis.

A shrub. Leaves about 6–7 cm. long and 2·5–3 cm. broad (younger leaves very thinly hairy). Flowers rather numerous, axillary; pedicels drooping, more than 1 cm. long. Calyx about 4 mm. long, covered externally by glistening golden-brown hairs. Corolla-tube 4 mm., segments ovate concave. Stamens extrorse; staminodes completely excluding all unnecessary insects. Ovary 5-lobed, with 1 seed in each loculus. Near *S. microlobum*, Baker (Journ. Linn. Soc. xxv. 333).

In woods, Fort Dauphin, 2969!

SIDEROXYLON MICROPHYLLUM, sp. n.

Arbusculum, ramis junioribus hirsutis demum glabratis pallidis corrugatis, foliis parvis obovatis obtusis subglabris margine revoluto, floribus 1–3nis axillaribus, calycis segmentis suborbicularibus, corollæ segmentis ovatis, filamentis 5 corollam æquantibus, staminodiis petaloideis ovatis ciliatis inflexis, stylo exserto.

A much-branched shrub. Leaves 2–2·6 cm. long and 6–9 mm. broad; petiole very short; branches and petioles covered at first with glistening golden-brown caducous hairs. Pedicels about 5 mm. long. Flowers about 5 mm., of which the calyx

occupies 2–3 mm. Anthers large, laterally dehiscing; staminodes shorter than the petals.

Sand dunes, Fort Dauphin, 2988!

EBENACEÆ.

Diospyros, sp. n.

Woods, Fort Dauphin, 2473!

OLEACEÆ.

Noronhia divaricata, sp. n.

Arbuscula, ramis oppositis numerosis pallidis glabris, foliis variis lanceolatis ovatis vel obovatis acutis vel obtusis etiam emarginatis coriaceis glabris margine revoluto, paniculis quasi trichotomiis, bracteis parvis rotundatis, corollæ tubo brevissimo in campanulam magnam carnosam ampliato, staminibus 2, antheris lateraliter dehiscentibus, ovario biloculari, loculis 2-ovulatis.

Shrub or small tree with spreading opposite branches. Leaves very variable in shape, usually (excluding petiole) 4–5 cm. long and about 2 cm. broad; petiole 2–4 mm. Peduncles about 3 cm., with minute triangular bracts; pedicels about 1 cm. long. Calyx 1–2 mm.; segments obtuse, ciliate at margin. Corolla with a very short tube and a broad fleshy campanulate throat, about 5 mm. in diameter; teeth 4, short and rounded. Stamens 2, with subsessile anthers dehiscing laterally. Ovary small, ovoid, with sessile bilobed stigma.

Woods near Fort Dauphin, 2883!

APOCYNEÆ.

Ellertonia, sp. n.

This appears to be *Plectaneia*, sp. (*cf.* Thouars, Gen. Nov. Madag. p. 11), in spite of the "semina marginibus affixa," which probably does not mean attached by their margins, but attached to the margins of the carpels. The ovary is of two distinct carpels though it seems single (*cf.* "ovarium unicum," *loc. cit.*). See also D. C. Prod. viii. p. 324.

Woods near Be'vooy, E. Coast, 2289!

Mascarenhaisia speciosa, sp. n.

Arbuscula, ramis griseis glabris, foliis ellipticis acuminatis ad

apicem rotundatis, glaberrimis, margine revoluto, floribus axillaribus solitariis basi bibracteolatis, calycis segmentis lanceolatis acutis 1–2-glandulosis, corollæ tubo elongato ad faucem campanulato, lobis 5-nerviis calloso-mucronulatis, folliculis longissimis angustis, seminibus numerosis elongatis oblongis apice breviter comosis.

A shrub or small tree with rugose greyish bark and glabrous in all parts. Leaves 3·5–4·5 cm. long and 1–1·5 cm. broad; petiole 2–3 mm. Pedicels erect, 2 cm. Calyx about 7 mm. long; segments green, with a marked revolute edge. Corolla pink, very handsome; tube 4 cm. long, widening into an infundibular-campanulate throat about 3 cm. in diameter; lobes ending in a short blunt, slightly thickened tip. Follicle 20 cm. or more long, and 2–3 mm. broad; seeds about 1 cm., with a small apical tuft of brown hairs.

Woods on road to south of Vaingaindrano, 2155! 2177!

ALYXIA POLYSPERMA, sp. n.

Frutex, ramis glabris rugosis, foliis ternatis oblongis subacutis coriaceis venis obscuris margine revoluto, cymis terminalibus axillaribusque trichotomiis corymbosis 9–30-floris, calycis segmentis parvis ovatis obtusis, corollæ tubo interne ad faucem villoso, drupa moniliformi, seminibus 1–6 (ad 10), albumine haud ruminato.

An erect glabrous shrub. Leaves minutely dotted below, attenuated at the base; blade 5–7 cm. long and 1·5–3·5 cm. broad; petiole about 5 mm. Peduncle 2 cm., with 1 or 2 leaf-like bracts. Flowers red. Calyx about 2 mm. long. Corolla-tube about 2 cm., slightly enlarged below the throat; lobes spreading, obtuse, about 3 mm. long. Anthers just inside the throat. Stigma with a reflexed membranous ring and minute lips. Fruit usually of 6 ovoid drupes with a leathery glabrous epicarp, osseous endocarp, and no rumination of the albumen *, about 6 cm. long.

Scattered broken woods (sandy soil), Fort Dauphin, 2374!

CARISSA (§ EUCARISSA) REVOLUTA, sp. n.

Frutex, ramis pallidis glabris, foliis ovatis obtusis rigide coriaceis breviter petiolatis margine valde revoluto, spinis

* *Cf.* Benth. et Hook. f., Gen. Plant. ii. 627. I find, moreover, in *Alyxia lucida*, Baker, no ruminated albumen.

pseudo-axillaribus simplicibus, cymis subterminalibus vel axillaribus, calycis segmentis acutis eglandulosis costa margineque ciliatis, corollæ segmentis obtusis tubum æquantibus, antheris sublanceolatis subsessilibus inclusis, stylo brevi, stigmate fusiformi labiis minutis, bacca ovoidea abortu 1-loculari, seminibus 2 magnis minute punctatis.

An erect branching shrub with yellow wrinkled bark entirely glabrous. Leaves very rigid, about 2·5–3·5 cm. long and 1·5–2 cm. broad; petiole 3 mm., slightly curved upwards. Corolla-tube 1·1 cm. long; segments ligulate. Ovary sub-1-locular; ovules more than 4. Berry ovoid, about 2 cm. long and 1 cm. in diameter, 2-seeded.

Scattered woods on sandy soil, Fort Dauphin, 3071!

GENTIANACEÆ.

Tachiadenus longifolius, sp. n.

Herba, ramis tetragonis glabris, foliis elongatis lanceolatis acutis ad basin attenuatis glabris margine revoluto, floribus solitariis brevi-pedicellatis, calycis tubo segmenta æquante ad costas in alas producto (more *T. carinoti*, Griseb.), capsula longa basi ventricosa, seminibus brunneis numerosis.

An erect simple glabrous herb about two feet high. Leaves 9–11·5 cm. long and 1·5–2·5 cm. broad, with a marginal vein about 2 mm. distant from the subrevolute edge. Flowers usually one in each axil of the last pair of leaves (pedicels 1·2 cm.). Calyx 4 cm. long; teeth about 1·6 cm.; ridges about 2 mm. in height. Capsule 6 cm. long, ventricose at base.

Open, rather marshy ground, Fort Dauphin, 2719!

LOGANIACEÆ.

Nicodemia grandifolia, sp. n.

Arbor, ramis obscure tetragonis glabris, foliis ovatis acutis vel acuminatis glabris margine revoluto, racemis terminalibus axillaribusque, bracteis linearibus ciliatis, calycis segmentis linearibus acuminatis apice calloso, corollæ tubo elongato, segmentis 4 parvis rotundatis, antheris 4 sessilibus inclusis, stigmate clavato, bacca ellipsoidea pubescente, pericarpio coriaceo, seminibus 15–20 trigonis, testa glutinosa.

A large tree with red glabrous branches. Leaves rather rounded at base, with a narrowly margined petiole, 10–14·5 cm. long and 4–5·5 cm. broad; petiole about 1 cm. Racemes about

5 cm. long, with 3–7 pairs of shortly pedunculate cymules; bracts 4 mm., pubescent. Sepals ending in a thickened subglandular point; calyx about 3 mm., scurfy pubescent. Corolla 1·5 cm. long, with 4 short rounded lobes very hairy externally. Berry 1·5 cm. long and 1 cm. broad, whitish and closely pubescent. Near *N. diversifolia*, but with much larger leaves.

Fort Dauphin, 2743!

Nicodemia diversifolia, var. lucida, nov. var.; arborea, ramis erectis, foliis ovatis ellipticis subacutis glabris (nisi petiolo ferrugineo-pubescente) lucidis.

Leaves 4·5–5·5 cm. long and 2–2·5 cm. broad.

Woods near Fort Dauphin, 2812! 2833!

CONVOLVULACEÆ.

Bonamia Thouarsii, sp. n.

Frutex, ramis divaricatis dense velutino-pubescentibus, foliis ellipticis acutis subcuspidatis breviter petiolatis, supra demum glabratis subtus velutino-pubescentibus, racemis terminalibus brevibus paucifloris, bracteis parvis, pedicellis brevibus supra basin articulatis, calycis segmentis oblongis emarginatis dorso villosis, corollæ urceolaris segmentis triangularibus externe hirsutissimis, stylo brevi, stigmate subbilobo.

A low branching shrub. Branches covered with thick golden velvety tomentum when young. Leaves densely hairy below, eventually almost glabrous on the upper surface, 3–4 cm. long and 1·5–2·5 cm. broad, with a petiole 5 mm. Calyx-segments about 5 mm. long and almost as broad. Corolla with triangular lobes externally covered with long golden hairs; within quite glabrous; margins inflexed, cartilaginous. Capsule glabrous.

Woods near Fort Dauphin, 2688!

Distinguished from *B. madagascariensis* by its pubescence and other points.

SCROPHULARINEÆ.

Leucosalpa, gen. nov. Scrophularinearum.

Calyx campanulatus minute 5-dentatus puberulus. Corollæ tubus elongatus cylindraceus incurvus superne parum ampliatus; lobi 5 breves dorso villosi subæquales rotundati. Stamina 4 didynama inclusa; antheræ discretæ subparallelæ basi longe attenuatæ filiformes. Stylus corollam paullo superans, stigmate

terminali bifido; ovula in loculis pauca (ad 4). Capsula ellipsoidea carnosa subapplanata. Fruticulus divaricate ramosus siccitate nigricans, ramis striatis pubescentibus. Folia opposita ovata acuta petiolata subtus pubescentia. Racemi terminales et axillares multiflores; pedicelli bibracteolati; bractei foliis subsimilares. Bracteolæ lineares. Corolla alba majuscula.

LEUCOSALPA MADAGASCARIENSIS, *S. Elliot.* (Plate VIII.)

A low shrub, turning black when dry, with terete branchlets covered with yellowish scurfy pubescence. Leaves unequal-sided, 2·5–4·5 cm. long and 1–1·5 cm. broad. Racemes very dense, with axis and pedicels scurfy pubescent. Calyx coriaceous, slightly enlarged in fruit, about 5 mm. Corolla very long, 7–8 cm., and about 1 cm. wide at the throat, with short (3 mm.) rounded lobes. Anthers attached at apex and prolonged downwards into long (3 mm.) parallel filiform horns.

Near Fort Dauphin, July, 2530!

The affinity of this curious plant seems very doubtful, but it is certainly most nearly allied to *Rhadamœa* and *Rhaphispermum* in Scrophularineæ.

LENTIBULARIEÆ.

UTRICULARIA PREHENSILIS, *E. Mey.*

New to Madagascar.

Plains near Bévooy (East Coast), 2276!

BIGNONIACEÆ.

COLEA COCCINEA, sp. n. (Plate IX.)

Arbor, ramis albidis corrugatis, foliis oppositis glabris 3–5-jugis, rhachide supra canaliculata ad petiolulos articulata, foliolis oblongis vel oblanceolatis obscure serratis apice brevissime obtuseque acuminatis petiolulatis, cymis congestis axillaribus brevissime pedunculatis, pedicellis cernuis, calyce campanulato subcoriaceo lacerate 5-fido, corolla campanulata infundibulari glabra, segmentis late obovatis, antheris discretis apice mucronulato; disco parvo; ovario distincte 2-loculari.

Leaves 15–30 cm. long, with the rhachis furrowed and striate, jointed at insertion of leaflets; leaflets increasing in size from below upwards; terminal leaflet 6–9 cm. long and 2–3·5 cm. broad, pedicels about 1·5 cm.; bracts minute, ovate-triangular. Calyx about 1·2 cm. long and about 1 cm. broad. Corolla 5 cm.

(2 inches) long and 2·5 cm. broad at the throat, scarlet; lobes about 1 cm. long. Anthers about 3 mm.; filaments thickened, hairy at base. Ovary bilocular.

This species is very close to *Kigelia madagascariensis*, Baker (Journ. Linn. Soc. Bot. vol. xviii. p. 274), and therefore shows the close connection of the two genera; but as the ovary is distinctly 2-locular, I have put this species in *Colea*, following Dr. Baillon.

Woods, Fort Dauphin, 2640!

ACANTHACEÆ.

FORSYTHIOPSIS AUSTRALIS, sp. n.

Frutex, ramulis tetragonis albidis glabris, foliis sæpius obovatis vel oblanceolatis acutis vel obtusis etiam emarginatis margine revoluto, floribus pedunculatis solitariis vel 1–3nis, bracteis linearibus, calycis 5-partiti segmentis linearibus acutis, corolla sub 2-labiata, segmentis quam tubus longioribus, staminibus 2, staminodiis anantheris minutis, disco cupulari, ovulis in loculis 2–3

An erect much branched shrub, with white or brown bark. Leaves crowded, inserted on cupular woody dilatations of the nodes, very slightly pubescent when young, afterwards wholly glabrous; usually 4–6 cm. long and about 2·5 cm. broad, though sometimes even 9 cm. long. Peduncles up to about 1·5 cm. long; bracts about 5 mm.; pedicels 1–2 cm. Calyx about 6 mm., with ciliate segments. Corolla-tube 6–7 mm., segments 13 mm. long and about 6 mm. broad, obtuse, externally minutely hairy. Stamens 7–8 mm.

Exposed stony and rocky places, Fort Dauphin, 2701! 2586! 2503!

CAMAROTEA, gen. nov. Acanthacearum tribus Ruelliearum.

Bracteæ foliis similares; bracteolæ parvæ obtusæ ovatæ. Calyx basi campanulatus, segmentis quam tubus longioribus lineari-lanceolatis acutis. Corolla tubulosa elongata incurva supra ovarium constricta, ad faucem gradatim ampliata, segmentis brevibus ovatis subæqualibus. Stamina 4 didynama, exserta, infra medium tubi affixa, filamentis in membranam decurrentem connatis; antheræ 2-loculares. Discus magnus cupularis

5-dentatus ovarium cingens. Stylus recurvus; stigma terminale subbilobum; ovula in quoque locula pauca (2–4) basi placentæ prominulæ collateraliter affixa. Capsula matura, haud visa.

Frutex glaber. Folia opposita parva ad apices ramulorum aggregata glabra breviter petiolata. Flores rubri axillares solitarii sessiles vel brevissime pedicellatæ.

CAMAROTEA SOUIENSIS, *S. Elliot.* (Plate X.)

Branches slightly four-sided, with rugose greyish bark. Leaves (on contracted branchlets about 1 cm. long) ovate obtuse, coriaceous, subrevolute at the edge; excluding petiole, 1–1·5 cm. long and 7–10 mm. broad; petiole about 5 mm., inserted on a woody cupular pulvinule. Bracts 2–3 mm. Calyx-tube 2–3 mm., segments 4–5 mm. long, glandularly hairy. Corolla scarlet, very similar to that of *Halleria* and *Phygelius*, about 3 cm. long and 6 mm. broad, curved upwards and contracted above the ovary. Stamens exserted, the lower pair projecting 1 cm. out of the corolla, the upper slightly shorter. Style curved upwards so as to lie above the anthers. (Fertilized by *Nectarinia souimanga.*)

Woods and thickets, Fort Dauphin, 2638!

JUSTICIA (§ ROSTELLULARIA) ARIDA, sp. n.

Fruticosa, ramis teretibus geniculatis pubescentibus cum foliis siccitate nigricantibus, foliis parvis ovatis vel lanceolatis obtuse acuminatis, margine revoluto subcrenulato, cymis parvis 3–4-floris scorpioideis breviter pedunculatis, calycis 4-fidi segmentis ovatis obtusis, corolla parva externe villosa, stylo villoso, capsula ovata, seminibus retinaculis magnis fultis.

Erect or prostrate, with branches slightly swollen at the nodes. Leaves marked by conspicuous rhaphides on upper surface; blade 2–4·5 cm. long and 1–1·6 cm. broad; petiole 5 mm. Spikes under 1 cm. in length; bracts small, triangular; bracteoles minute. Calyx about 3 mm. long. Corolla twice as long as the calyx (corolla-tube 4 mm.). Filaments hairy; both anther-loculi mucronate at base. Nectary large, cupular, about half as long as the ovoid ovary. Capsule ovoid.

Undershrub in forests and exposed places near woods, Fort Dauphin, June, 2875! 2820! 2715!

JUSTICIA (§ ROSTELLULARIA) BAILLONI, sp. n.

Frutex, ramulis elatis teretibus geniculatis puberulis, foliis elongatis ellipticis obtusis acuminatis ad basin attenuatis margine subrevoluto, spicis axillaribus solitariis floribus numerosis

densis subsecundis, bracteis parvis triangularibus, bracteolis ovatis ciliatis, calycis 4-partiti segmentis linearibus acutis margine ciliato, corolla externe pubescente, ad faucem 4-saccata.

A shrub with green branches. Leaves unequal-sided, elliptic or oblong, conspicuously lineolate on both surfaces, prominently veined; (excluding petiole) leaves 9–10 cm. long and 2·5–3 cm. broad; petiole 1–1·5 cm. Spikes 3–4 cm. long; rhachis furrowed; bracts small, triangular; bracteoles ovate, 2–3 mm. long. Calyx about 5 mm. Corolla 1–1·5 cm. long; tube about 5 mm., completely closed at the throat by four hairy pouches at the base of the stamens. Nectary cupular.

Woods near Fort Dauphin, May, June, 2707!

JUSTICIA (§ ROSTELLULARIA) DELICATULA, sp. n.

Herba minuta, ramis tetragonis, foliis ovatis vel oblongis obtusis rubro-variegatis dense lineolatis breviter petiolatis, spicis simplicibus gracilibus, floribus parvis dissitis subsecundis, bracteis linearibus acuminatis, calycis 4-partiti segmentis angustis linearibus ciliatis, corolla parva externe villosa, capsula ad basin apicemque attenuata, seminibus echinulatis.

Stems very small (under 6 inches), lineolate, simple (at least in my specimens). Leaves densely covered on both sides by prominent rhaphides, midrib and larger nerves broadly marked in reddish-yellow; usually 1·5–2·5 cm. long and 1–1·5 cm. broad; petiole about 5 mm. Spikes 5–10 cm. long; flowers about 1 cm. apart; bracts linear acuminate; braceoles ovate. Calyx 2–3 mm. long. Corolla 5–6 mm., with the tube not longer than the lips. Nectar cupular. Capsule 5–6 mm. long, with ovoid echinulate seeds

Woods, Fort Dauphin, April, May, 2507! 2489!

JUSTICIA (§ ANISOSTACHYA) BAKERI, sp. n.

Herba, ramis dichotomis 2-sulcatis, in sulcis dense hirsutis, foliis late ovatis obtusis margine revoluto, spicis solitariis longe pedunculatis 16-20-floris, bracteis exterioribus magnis obovatis spathulatis ciliatis, bracteolis linearibus, calycis segmentis linearibus ciliatis (posteriore breviore) corollæ tubo quam labium longiore, capsula oblonga acuta, seminibus 2 tuberculatis.

A decumbent herb. Branches marked by a double line of hairs continued along the petiole and peduncle, otherwise glabrous. Leaves very broadly ovate; blade 1–2 cm. long and 1–1·5 cm. broad; petiole about 7 mm. Spikes 3–5 cm. long, the

upper half closely covered by 4-ranked sessile flowers. Bracts 6–7 mm. long and 2 mm. broad, 3–5-veined; bracteoles linear, about 4 mm. Calyx-teeth as long as the bracteoles, with a thickened midrib. Corolla externally hairy; lower lip 3-fid with obtuse segments (the middle one broadest). Filaments and inner part of corolla hairy.

Grassy hills, Fianarantsoa, 2075!

JUSTICIA (§ ANISOSTACHYA) HILARIS, sp. n.

Frutex, internodis brevissimis, ramulis subtetragonis glabris, foliis elongatis linearibus obtusis ad basin attenuatis glabris, margine revoluto, spicis terminalibus, bracteis obovato-spathulatis rubris speciosis 5-nerviis, bracteolis et calycis segmentis linearibus acutis ciliatis, corolla calycem paullo superante usque ad medium fissa, capsula ovoidea acuta, seminibus echinulatis.

A low-growing shrub with nodes only 5 mm. to 1 cm. apart, glabrous in all parts. Leaves lineolate above, paler in colour below, 6–8 cm. long and 5–8 mm. broad. Peduncle 2 cm., bearing two spikes 2–4 cm. long. Bracts opposite, alternately fertile, submucronate; the basal third rigid and green; the upper two-thirds expanded, bright red, membranous, about 5 mm. long and 3 mm. broad. Bracteoles and calyx-segments about as long as the bracts, also red above and greener at base. Corolla with an obtuse upper lip and broad 3-lobed lower lip. Staminal filaments hairy. Nectary very small. Capsule elliptic-acute, reddish at the tip.

Thickets, &c., Fort Dauphin, 2654!

HYPOESTES LONGILABIATA, sp. n.

Fruticosa, ramulis tetragonis lineolatis, foliis ovatis vel lanceolatis obtusis vel acutis utrinque lineolatis ad lineam stipularem villis perpaucis albidis notatis, margine revoluto integro rarius crenulato, floribus paniculatis sessilibus, involucri uniflori bracteis rigidis linearibus subtrigonis acutis, calycis segmentis acuminatis ciliatis, corollæ rubellæ tubo limbos æquante quam involucrum duplo longiore, seminibus 4 glabris.

An erect leafy, much branched shrub. Leaves and branches (though conspicuously lineolate) entirely glabrous except for a row of white hairs at the stipular line. Leaves sometimes crenulate, variable in size, from 5–9·5 cm. long, excluding petiole (about 1 cm.). Bracts minute, triangular. External bracts of involucre scabrous, about 1·2 cm. long, inner slightly shorter, with

white membranous inflexed margins. Calyx-tube about 3 mm.; segments 4 mm. Corolla densely pubescent, externally pinkish white, about 4–5 cm. long; the upper lip 5 mm. broad at the tip; with short rounded lobes.

In open woods and scattered thickets, Fort Dauphin, July, 2677! 3000!

HYPOESTES INCOMPTA, sp. n.

Herbacea, ramulis tetragonis hirsutis, foliis ovatis obtusis breviter petiolatis utrinque hirsutis, spicis terminalibus, bracteis alterne sterilibus minutis linearibus, involucri uniflori bracteis rigidis oblongis apice triangularibus hirsutis, calyce 5-fido bracteas interiores æquante, segmentis lineari-lanceolatis, corolla tubulosa usque ad medium fissa quam involucrum 2–3plo longiore, labii superioris lobis ovatis.

An erect straggling plant, densely hairy in all parts. Leaves (excluding petiole) 3–4·5 cm. long and 1·5–3 cm. broad; petiole about 5 mm.; both sides of leaf covered with long white hairs. Bracts ovate (3 mm. long). Involucral bracts dissimilar; *outer* narrow, oblong, rigid, channelled and glabrous within, somewhat twisted at the tip; *inner* narrow, linear, and much shorter. Calyx membranous, segments as long as the tube. Corolla about 3 cm. long; lower lip almost 1 cm. broad at the tip, with obtuse segments.

Fort Dauphin, 3067!

HYPOESTES GLANDULIFERA, sp. n.

Fruticosa, ramulis tetragonis villosis, foliis ovatis basi subcordatis acutis breviter petiolatis utrinque dissite villosis, spicis terminalibus simplicibus vel parce ramosis, bracteis alterne sterilibus magnis obovato-spathulatis, involucri uniflori bracteis glanduloso-hirsutis, exterioribus obovatis obtusis quam interiores lanceolati duplo longioribus, calyce 5-fido bracteas interiores æquante, corollæ rubræ tubo curvato-infundibulari quam involucrum 3–4plo longiore, labii superioris lobis parvis rotundatis.

Erect leafy shrub, with the branches covered with rather long distant white hairs. Leaves sometimes bluntly acuminate, (excluding petiole) 2·5–5 cm. long and 1·5–2 cm. broad; petiole 5 mm. (or less). Bracts about 4–5 mm. *External* involucre-bracts large, obovate, spathulate, with a rigid claw about 9 mm. long and 5 mm. broad; *inner* involucral bracts lanceolate acute, 4–5 mm. long; all the bracts thickly covered at the margin with stalked glandules.

Calyx as long as inner bracts. Corolla 3 cm. long, pink, curved, with a very short upper lip (not more than 1 cm.) and obtuse lobes.

Woods (white sand), Fort Dauphin, June, 2938!

VERBENACEÆ.

VITEX TRISTIS, sp. n.

Frutex, ramis nigris striatis junioribus villosis, foliis simplicibus oblongis obtusis vel emarginatis coriaceis glabris margine revoluto, cymis axillaribus brevi-pedunculatis 5-floris, bracteis ellipticis oblongis, calyce campanulato 5-dentato, corolla curvato-tubulosa externe villosa, antheris reniformibus, drupa pallide viridi rugosa glabra.

An erect shrub, with the younger branches slightly flattened and covered with a few scattered golden-brown hairs. Leaves almost glabrous, veins prominent on both surfaces; blade 6–9 cm. long and 3–4·5 cm. broad, with petioles 1–2 cm. long. Flowers in axillary and terminal shortly pedicellate cymes; bracts 1 cm. long and 6 mm. broad. Calyx about 1·8 cm. long and 1 cm. broad at the throat, with short rounded teeth. Corolla slightly longer than the calyx, with acute hairy segments. Anthers rolling forward by pairs to dehisce. Style exserted, with obtuse lips.

Woods near Fort Dauphin, 2612!

VITEX BRACTEATA, sp. n.

Frutex, ramis pubescentibus, foliis oblongis vel ovatis obtusissimis vel emarginatis supra glabratis subtus dense tomentosis, pedunculis elongatis pubescentibus 2–3-floris, bracteis ovatis reticulato-venosis, calyce campanulato 10-nervio externe villoso, corolla elongata curvata villosa, antherarum loculis parallelis, drupa obovoidea rugosa pallide viridi calyce inclusa.

An erect branching shrub with white wrinkled bark; younger branches covered with golden-brown velvety pubescence. Leaves densely hairy on the nerves below, coriaceous, subrevolute, usually 4–5·5 cm. long and 3–5 cm. broad; petiole 2 cm. Bracts 1 cm. long and 5 mm. broad. Calyx about 1–3 cm. long, campanulate-infundibular, externally pubescent. Corolla red, 1·7 cm. long and 6 mm. broad, externally very shaggy, contracted above the ovary; lobes short. Fruit 6–7 mm. long and 4 mm. broad.

Woods (on sandy soil), Fort Dauphin, 2467!

Cœlocarpus madagascariensis, sp. n.

Perennis, ramis dichotomiis ascendentibus scabridis ad nodos lignosis cupularibus, foliis oppositis variis sæpius oblongis vel lineari-lanceolatis etiam basi lobatis subhastatis obtusis utrinque hirsutis, racemis terminalibus, pedicellis brevibus alternis basi articulatis, calycis infundibularis segmentis hirsutis mucronulatis quam tubus triplo brevioribus, corolla infundibulari ad faucem villosa, staminibus 4, antheris cordatis, fructu calyce incluso bilobo glabro sicco.

An erect, dichotomously branched scabrous herb. Leaves very variable by greater or less development of basal lobe, shortly petiolate; blade 2–3 cm. long and 6–15 mm. broad. Racemes 4–8 cm. long, with flowers alternately developed along the axis. Pedicels about 3 mm., slightly expanded below the flower. Calyx hairy; teeth spreading, mucronate, about 5–6 mm. long; calyx-tube 4 mm. Corolla slightly longer than the calyx, with short rounded segments. Stamens subdidynamous. Fruit about 4 mm. long, ovoid, dry, and somewhat bilobed. Cf. *C. socotranus*, Balf. f. in Proc. Roy. Soc. Edinb. xii. (1883).

Open sandy ground, Fort Dauphin, 2342!

Acharitea glandulosa, sp. n.

Suffrutex, ramulis striatis obscure tetragonis, foliis linearibus vel lineari-lanceolatis acutis glanduloso-pilosis margine revoluto, spicis terminalibus axillaribusque densis, floribus 2–3nis, bracteis ovatis acutis hirsutis, calyce infundibulari 10-nervio glanduloso-hirsuto, corollæ segmentis parvis obtusis, staminibus infra medium tubi affixis, ovario ovoideo 2-loculari, loculis monospermis, albumine copioso.

An erect herb 1–3 feet high, glandular-hairy in all parts. Leaves black above, greener below, 3–5 cm. long and about 5 mm. broad. Flowers very dense, almost secund, in spikes 2 cm. or more long; bracts 8 mm. long and 5 mm. broad. Calyx 4–5 mm., with 5 short ovate acute teeth. Corolla about 1 cm., with 5 short rounded lobes. Anther-loculi parallel, shortly mucronate at base. Style exserted; fruit enclosed in persistent calyx, about 2 mm. long.

Open ground (on sandy soil), Fort Dauphin, 2734! 2375!

LABIATÆ.

Plectranthus hoslundioides, sp. n.

Frutex, ramis crassis junioribus hirsutis, foliis congestis ovatis obtusissimis crenatis utrinque hirsutis, racemis terminalibus 6-verticillatis, verticillis 8–12-floris, calycis segmentis primo acuminatis subæqualibus, calyce fructifero ampliato ovoideo ad faucem angustato 10-nervio, corollæ tubo elongato, labio inferiore parvo, nuculis villosis.

Stem thick and woody (6 mm. in diameter). Leaves 4–6 cm. long and 1–2 cm. broad, unequal-sided, and with an enlarged pulvinus. Racemes 8–10 cm. long. Bracts small, ovate; pedicels 6–10 mm. Calyx in fruit about 1 cm. long and 6 mm. broad.

Woods near Fort Dauphin, 2645!

Plectranthus canescens, *Benth.*, var. membranacea; foliis magnis ovatis subacutis ad 20 cm. longis, basi cordatis, subglabris. Pedunculis parce ramulosis.

Fort Dauphin, 3072!

PHYTOLACCACEÆ.

Barbeuia madagascariensis, *Steud.*

My specimens show the fruit, which has not been before collected. It is a hard woody unilocular capsule about 1 cm. long, and encloses a single seed surrounded by a fibrous yellow aril and with a black tuberculate testa; the seed is subglobose; the cotyledons are very large, unequally developed, with minute accumbent radicle.

Woods, Fort Dauphin, 2880! 2748! also 2247!

CHENOPODIACEÆ.

Basella excavata, sp. n.

Ramis striatis glabris, more *Cassythæ* volubilibus, foliis perpaucis subcordatis acutis crassis rugulosis, floribus numerosis spicatis in rhachide excavata sessilibus, bracteola infra-florali minuta acuminato-triangulari, bracteis floralibus suborbicularibus liberis, perianthio 5-partito, staminibus lateraliter dehiscentibus, utriculo ovoideo capsulari.

A prostrate twining parasitic plant very like *Cassytha* in appearance. Leaf 1·5 cm. long (including 5 mm. of petiole) and 1 cm. broad. Spikes 4 cm. long, with numerous flowers imbedded in the fleshy rhachis. Flowers about 2 mm. long, Utricle

enclosed in a persistent perianth, quite glabrous, ovoid, conical at the tip.

Usually open country on bushes, Fort Dauphin, 2635!

LAURINEÆ.

Mespilodaphne madagascariensis, *Meissn.*

Ex descr. No specimens either at Paris or Kew. 2422!

Ravensara parvifolia, sp. n.

Frutex, ramis rugosis, foliis oppositis ovato-lanceolatis vel obovatis obtusis supra nitidis subtus pallidis coriaceis breviter petiolatis, cymis axillaribus paucifloris, bracteis ovatis minutis ciliatis, perianthii segmentis rotundatis, antheris magnis carnosis.

A shrub with brown, irregularly furrowed branches. Leaves shining above, paler and prominently veined below, usually 3–5 cm. long, 1·5–2·5 cm. broad; petiole 2–3 mm. Flowers about 5 mm. in diameter, externally glabrous. Easily distinguished from the other species by the small leaves.

Woods, Fort Dauphin, 3081!

Cryptocarya glaucosepala, sp. n.

Arbor, foliis obovatis rarius oblongis obtusis vel emarginatis supra glabris subtus glaucis prominente reticulato-venosis, paniculis quasi terminalibus quam folia brevioribus obsolete bracteatis, perianthii segmentis 6 inflexis, staminibus quarti ordinis parvis crassis villosis, staminibus tertii ordinis glandulas conicas brevissime pedunculatas ferentibus, ovario parvo globoso.

A tree with red striate bark. Leaves variable, ovate or more usually obovate or oblong; blade 8–10·5 cm. long and 3–4 cm. broad; petiole rugose, rather flattened, 1–1·5 cm. Peduncles 1·5 cm; pedicels 3–4 mm. Flowers 4–5 mm. in diameter. Perianth (as well as peduncle and pedicels) externally bluish, glaucous and villous. Stamens as long as perianth; those of 3rd order with pyramidal glands; those of 4th order sessile, about 1 mm. long.

Woods near Fort Dauphin, 2859!

LORANTHACEÆ.

Viscuom dicthomum, *D. Don.*

New to Madagascar.

Woods, Fort Dauphin, 2682!

LORANTHUS (§ DENDROPHTHOË) GRISEUS, sp. n.

Glaber, ramis teretibus griseis, foliis ovatis vel obovatis obtusissimis breviter petiolatis pallidis crassis coriaceis, floribus 5-meris subumbellatis 2–3nis brevissime pedunculatis, bractea unilateraliter saccata, calycis parvi ore minute 5-denticulato, corollæ rubræ tubo cylindraceo elongato, disco tumido nigro, filamentis brevibus, stylo 10-sulcato, stigmate supra hemisphærico.

Branches terete, grey, smooth and shining when old. Leaves obscurely veined, unequal-sided, including petiole 6–9 cm. long and 3·5–5 cm. broad. Peduncles and pedicels both about 5 mm. long. Calyx glabrous, about 5 mm. Corolla red, about 4 cm. long, externally minutely pubescent, within scabrously hairy. Anthers 7 mm. long. Style with 10 distinct furrows; capsule oblong.

Woods between Vaingaindrano and Fort Dauphin, 2260! 2261!

LORANTHUS (§ DENDROPHTHOË) SORDIDUS, sp. n.

Glaber, ramulis teretibus transverse corrugatis minuteque longitudinaliter striatis, foliis obovatis obtusissimis coriaceis sordido-ferrugineis rigide coriaceis e basi obscure 3-nerviis, floribus 5-meris axillaribus solitariis, bracteola minuta unilaterali, calycis segmentis oblongis obtusis, corollæ tubo elongato rubello usque ad medium fisso, supra basin leviter constricto, fructu cylindraceo.

Branches red, always glabrous. Leaves sometimes ovate, dull rust-coloured, unequal-sided, 2·5–4 cm. long (including petiole) and 1·5 cm. broad. Calyx-tube 4 mm. long; teeth oblong, fully 3 mm. Corolla-tube 4·5 cm. long, glabrous. Disk small. Fruit about 1 cm. long.

Woods near Fort Dauphin, 2582!

THYMELEÆ.

STEPHANODAPHNE CREMOSTACHYA, *Baill.*
Only in the Paris Herbarium.
Woods, Fort Dauphin, 2403!

LASIOSIPHON SAXATILIS, sp. n.

Frutex, ramis striatis junioribus hirsutis, foliis obovatis vel oblongis emarginatis vel obtusis subapiculatis supra tenuiter pilosis subtus villosis subsessilibus, pedunculo brevi, bracteis

ovatis basi latis acutis, floribus subcapitatis, perianthii tubo elongato extus sericeo-tomentoso, lobis oblongis obtusis, squamis ovatis basi subcordatis.

A shrub 2–3 feet high; branches silky hairy when young, becoming glabrous, red and rugose with age. Leaves about 2 cm. long and 1 cm. broad, densely hairy below but becoming glabrous (except for a few scattered hairs) above. Peduncles about 1 cm. Capitula many-flowered; bracts 5–7 mm. long and 3 mm. broad at base. Corolla-tube about 1 cm., with segments 3 mm. long. Stamens, 5 almost exserted and 5 halfway down the tube. Scales shorter than corolla-lobes.

Rocky places near Fort Dauphin, 3030!

Lasiosiphon Hildebrandtii, sp. n.

Frutex, ramulis nigris junioribus sericeo-pubescentibus, foliis oblanceolatis obtusis vel acutis etiam subcuspidatis ad basin attenuatis utrinque appresse pilosis, capitulis longe pedunculatis, bracteis ovatis acuminatis villosis, perianthii tubo elongato externe dense villoso, segmentis obtusis vel emarginatis, squamis oblongis, ovario hirsuto.

A shrub 2–3 feet high, with softly pubescent stems and leaves crowded at the ends of the branches. Leaves covered on both sides with soft silvery hairs, usually 2·5–4·5 cm. long and 6–15 mm. broad. Corolla about 1·5 cm. long; lobes 5 mm.; scales 2–3 mm. Stigma very hairy.

Hildebrandt, 3369! Open places amongst rocks. Fort Dauphin, *Scott Elliot*, 2368!

EUPHORBIACEÆ.

Euphorbia mancinella, *Baill.*

Commerson! Only at Paris.

Near Fort Dauphin, 2669!

Euphorbia lophogona, *Lam.*

A very curious species, hitherto only gathered by Commerson.

Woods, Fort Dauphin, 2673!

Euphorbia Commersonii, *Baill. in Bull. Linn. Soc. Par.* i. p. 623; floribus breviter pedunculatis, bracteis latis obovatis, involucro cupulari 5-glanduloso, squamis ovatis laciniatis glandulis alternis circa ovarium conniventibus auctis, basi ciliatis.

Thickets, Fort Dauphin, 2594!

Phyllanthus cryptophilus (syn. *Monarda cryptophila* Juss.).

Open country, Fort Dauphin, 2599!

Suregada crenulata, *Baill.*

Woods, Fort Dauphin, 2801!

Leptonema venosum, *A. Juss.*

Another very curious and hitherto unique Commersonian plant. 2448!

Saavia (§ Charidia) revoluta, sp. n.

Frutex ramosissimus, ramulis primo rubris demum albidis lenticellatis obscure hirsutis, foliis ovatis vel lanceolatis coriaceis (præter petiolum tenuiter hirsutum) glabris margine revoluto, floribus in cymas brevissimas axillaribus aggregatis, masculis femineisque mixtis, bracteis bracteolisque parvis ciliatis, pedicellis masculis quam feminei brevioribus rubris, sepalis masculis oblongis rubris membranaceis, sepalis femineis coriaceis viridibus inæqualibus, petalis sexu utroque similaribus oblongis apice acutis inflexis, disci segmentis 5 parvis 3-fidis, staminibus 5 crassis, stylis ad basin 3-partitis.

Branches when young red, covered with short erect hairs. Leaves thick and rigid, with veins prominent on both surfaces closely reticulate, usually 2·5–5 cm. long and 1·5–3 cm. broad; petiole about 3 mm. Pedicels, ♂ about 7 mm., ♀ about 12 mm. long; sepals and petals 2–3 mm. Capsule about 1 cm. long, hard and woody.

Woods near Fort Dauphin, 2538! 2845!

Excœcaria glaucescens, sp. n.

Fruticosa, ramis glabris corrugatis, foliis elliptico-oblongis utrinque attenuatis glaucis glabris, margine serrato subrevoluto, venis supra prominentibus, stipulis triangularibus linearibus, spicis axillaribus vel quasi terminalibus, floribus dissitis, bracteis triangularibus acuminatis, calycis segmentis 3 triangularibus acutis apice rubro calloso; ♂ antheris 3 subsessilibus, ovarii rudimento 0; ♀ ovario sessili, stylis 3 recurvis leviter applanatis.

A shrub with the branches alternately flattened. Leaves 8–17 cm. long and 2·5–4 cm. broad, petiole less than 1 cm.; under surface marked by a peculiar calcium gland; bluish glaucous in colour with brown caducous stipules. Female spikes 4–12 cm. long, with about 10 distant flowers; mixed male

and female spikes longer, with numerous flowers (in the case of the males usually several flowers together). Styles 4 millim. long; mature fruit about 5 millim.

Woods near Fort Dauphin, 2916! 2423!

Claoxylon flavum, sp. n.

Frutex, ramis flavis junioribus pilis albis remotis adspersis, foliis lanceolatis basi cuneatis acutis sæpius obscure crenulatis breviter petiolatis costa inferiore petioloque pilosis ceteris glabris coriaceis, pedunculis solitariis axillaribus, floribus dissitis brevissime pedicellatis, bracteis parvis ciliatis, calycis masculi 4-partiti segmentis triangularibus, staminibus numerosis, ovarii destituto, calycis feminei 3-partiti segmentis, glandulis petala simulantibus crassis oblongis, stylis 3 reflexis supra laceris, capsula 3-loba, seminibus globosis tuberculatis.

A shrub with yellowish bark and rather leafy ascending branches. Leaves rugose on both sides, yellowish green with white nerves; variable in size, usually 5–11 cm. long and 1·5–2·5 cm. broad, petiole 5 mm. or less. Peduncles 3–5 cm. long; pedicels in male flower 2 mm., in female shorter; flowers not 2 mm. in diameter. Capsule deeply 3-lobed, about 3 mm. in diameter, obscurely hairy.

Woods near Fort Dauphin, 2852!

Cyclostemon aquifolium, sp. n.

Arbuscula, ramis obscure pilosis demum glabratis albidis corrugatis, foliis more *Ilicis Aquifolii* spinoso-dentatis glaberrimis prominente reticulato-venosis breviter petiolatis, floribus solitariis vel binis breviter pedicellatis, bracteis minutis hirsutis, calycis feminei segmentis 4–5 inæqualibus, 3 late obovatis apice subinflexis quam ceteri majoribus, disco magno cupulari, stylis 2 subelongatis, stigmatibus leviter incrassatis, ovario 2-loculari, ovulis in loculis 2, micropyle axin fructus spectante.

A small shrub which in foliage exactly resembles the ordinary Holly. Leaves 3·5–7·5 cm. long and 2–3·5 cm. broad; petiole channelled above, under 5 mm. in length. Pedicels about 6 mm. long. Calyx of 4–5 very unequal segments; the inner 2–3 mm. long, and rather broader. Mature capsule brown, ovoid, subfleshy, about 8 cm. long, with two free diverging styles about 3 mm. long (♂ flower not seen).

This extraordinary plant seems to have its nearest affinity in

C. natalense, Harv., but the styles are different to those of any species of the genus.

Woods, Fort Dauphin, 2873!

The following new Crotons have been described by M. Baillon as under:—

Croton Elliotianus, *Baill. in Bull. Linn. Soc. Par.* i. p. 863. 2970!

Croton inops, *Baill. l. c.* p. 864. 2986!

ORCHIDEÆ.

(By R. Allen Rolfe, A.L.S.)

Liparis bicornis, *Ridl.*

Wet marshy slope near A'Mpanjakao, Manandona Valley, Interior, 2004!

A little taller than specimens previously collected.

Liparis ornithorhynchus, *Ridl.*

Rather wet places near Fianarantsoa, 2065!

The specimens are slightly taller and stouter than those previously collected.

Bulbophyllum Baronii, *Ridl.*

In forest at Ankeramadinika, Tamatave to Capital, 1763! Shaded places in rock crevices, Andringitra, 5000 feet, 1827!

Bulbophyllum Humblotii, *Rolfe*, sp. n.

Rhizoma repens, gracile. Pseudobulbi ovoidei, 3–6 lin. longi, monophylli. Folia oblonga, crassiuscula, ½–1½ uncias longa. Scapi subsessiles, brevissimi, recurvi, basi vaginis membranaceis tecti. Racemi multiflori, rhachide acute subalata. Bracteæ ovatæ, acutæ, 1–1½ lin. longæ. Sepalum posticum ovatum, acutum, 1–1½ lin. longum; lateralia lanceolato-linearia. Petala oblonga v. lanceolato-oblonga, ¾ lin. longa. Labellum recurvum, carnosum, lineare, obtusum, medianis lineis bis carnosulis. Columna brevis, dentibus acutis columnam subæqualibus.

On trees in forest near Fort Dauphin, 2771! Without precise locality, *Humblot* 378! On trees by coast, Hirondio, July 1862, *Dr. Meller*.

This species much resembles *B. pendulum*, Thouars, in general habit, but among other differences that species has a two-leaved

pseudobulb. The present species is somewhat variable, certain specimens being nearly twice as large as others. The flower appear to be straw-coloured with bright yellow lip.

Bulbophyllum Pervillei, *Rolfe*, sp. n.

Rhizoma lignosum. Pseudobulbi compressi, suborbiculares approximati, 5–7 lin. longi, monophylli. Folia oblonga v. elliptico-oblonga, crassiuscula, $\frac{3}{4}$–1 unciam longa, 4–7 lin. lata. Scap suberecti, apice subnutanti, 5–9 uncias longi. Racemi laxiusculi, multiflori. Bracteæ ovato-oblongæ, acutæ, 1–1$\frac{1}{2}$ lin. longæ. Sepalum posticum deltoideo-lanceolatum, acutum, 2–2$\frac{1}{4}$ lin. longum; lateralia subsimilia, subfalcata. Petala linearia, subobtusa, 1 lin. longa. Labellum recurvum, lineare, subacutum, 1$\frac{1}{2}$ lin. longum, minute papillosum, marginibus tenuibus, medianis lineis bis carnosulis. Columna brevis, dentibus falcatis acutis.

In forest near Fort Dauphin (without number), Insula Nossibé, Julio 1840, *Pervillé*, 136. Without precise locality, *Humblot*, 380.

A markedly distinct species, somewhat resembling *B. erectum*, Thouars, in habit, but with less distant pseudobulbs and various other differences. Pervillé's specimen in Lindley's Herbarium is in fruit, but is so precisely similar in general character that I think it must belong to the same species.

Bulbophyllum Elliotii, *Rolfe*, sp. n.

Rhizoma lignosum. Psudobulbi compressi, suborbiculares, approximati, 5–7 lin. longi, monophylli. Folia oblonga v. elliptico-oblonga, crassiuscula, $\frac{3}{4}$–1 unciam longa, 4–7 lin. lata. Scapi breves, basi vaginis membranaceis tecti. Racemi multiflori, rhachide incrassata. Bracteæ triangulari-ovatæ, obtusæ, rigidæ, 1$\frac{1}{2}$–2 lin. longæ. Sepalum posticum triangulari-ovatum, acuminatum, papillosum, 1$\frac{1}{2}$ lin. longum; lateralia falcato-deltoidea, acuminata, papillosa. Petala falcato-subulata, acutissima, $\frac{3}{4}$ lin. longa. Labellum arctissime recurvum, lineare, obtusum, margine pectinato-fimbriatum, medianis lineis bis carnosulis. Columna brevis, dentibus subulatis acutis falcatis.

In forest near Fort Dauphin (without number).

Habit of *B. Pervillei*, Rolfe, but the pseudobulbs slightly more distant and the leaves a little larger. The inflorescence, however, is very different, and somewhat resembles that of *B. conitum*, Thouars, with dull maroon flowers. The strongly recurved, very fimbriate lip affords a marked character to the species.

Calanthe sylvatica, *Lindl.*
Near Fort Dauphin, 2357!

Eulophia vaginata, *Ridl.*
Below gneissose boulders, Ankaratra, 1967!

Eulophia macra, *Ridl.*
Near Fort Dauphin, 2967!

Eulophia Rutenbergiana, *Kränzlin.*
Wet places at base of Andringitra Mountain, Interior, 1843! In marshes near Arivonimamo, 1927!

Eulophia pandurata, *Rolfe*, sp. n.

Epiphytica. Pseudobulbi gracillimi, $\frac{3}{4}$–$1\frac{3}{4}$ uncias longi. Folia petiolata, lanceolato-oblonga, acuta, $1\frac{1}{4}$–$2\frac{1}{2}$ uncias longa, $\frac{1}{3}$–1 unciam lata. Scapus gracilis, 6 uncias altus. Racemus laxus. Bracteæ anguste lanceolatæ, acutæ, 4–6 lin. longæ. Sepala linearia, subobtusa, 3 lin. longa, lateralia carinata. Petala oblanceolata, subobtusa, sepalis paullo latiora. Labellum late panduratum, 4 lin. longum, trilobatum; lobis lateralibus rotundatis, medio lato retuso, carinis tribus, supra crenulatis; calcari $1\frac{1}{2}$ lin. longo, apice subincrassato. Columna crassiuscula, $1\frac{1}{2}$ lin. longa.

On trees in forest near Fort Dauphin, 2546!

A very marked species, quite unlike any other from Madagascar. The pseudobulbs are from $\frac{1}{2}$ to $\frac{3}{4}$ inch distant on the rhizome, and when young are covered with loose membranous sheaths.

Eulophia Elliotii, *Rolfe*, sp. n.

Terrestris, rhizomate repente. Folia angustissima, acuta, 8–12 uncias longa, 2–3 lin. lata. Scapi elati, graciles. Racemi laxi, 9–12-flori. Bracteæ anguste lanceolatæ, acutæ, 1 lin. longæ. Sepala lanceolato-oblonga, mucronulata, 4 lin. longa. Petala similia, paullo latiora. Labellum late cuneatum, $4\frac{1}{2}$ lin. longum, $6\frac{1}{2}$ lin. latum, trilobatum; lobis lateralibus rotundatis, obtusis, medio profunde bifido, lobulis obovatis obtusis; callis duobus magnis ad basin labelli; calcari lineari-oblongo, 2 lin. longo. Columna lata, fere 2 lin. longa.

On the ground near Fort Dauphin, 2424!

A tall and slender plant, with the unthickened pseudobulbs about an inch distant on the rhizome. The broad lip appears to

be bilobed, owing to the front lobe being deeply bifid. The crests are peculiar, and consist of a pair of triangular, obtuse, somewhat flattened processes, which are free above and nearly a line long.

EULOPHIA STRIATA, *Rolfe*, sp. n.

Terrestris. Folia longe petiolata, elongato-linearia, subacuta, 1¼–2 ped. longa, 1–1½ uncias lata. Scapi elati, graciles. Racemi laxi. Bracteæ angustissimæ, acutæ, 4–6 lin. longæ. Sepala oblongo-lanceolata, acuta, 4–5 lin. longa. Petala subspathulato-oblonga, acuta, striis tribus purpureis. Labellum late cuneatum, 4 lin. longum, 6 lin. latum, indistincte trilobatum, lobo medio profunde bifido; callis quatuor ad basin labelli, duobus linearibus in medio, duobus majoribus exterioribus; calcari saccato lato truncato, 1 lin. longo 1½ lin. lato. Columna brevis, lata.

On the ground near Fort Dauphin, 2545!

A tall and slender plant, with much broader leaves than the preceding. The petals have three purple lines on a paler ground, but the marginal pair are somewhat indistinct. The spur is curiously thickened; in front of it stand a pair of short linear calli, while outside of these and somewhat nearer the base are a second pair of larger, oblong, obtuse, and somewhat fleshy lobes.

CYRTOPERA PLANTAGINEA, *Lindl.*

Near Fort Dauphin?

POLYSTACHYA CULTRATA, *Lindl.*

Forest near Ankeramadinika, 1882! On trees, Fianarantsoa, 2080!

POLYSTACHYA ANCEPS, *Ridl.*

Forest near Ankeramadinika, 1874! 1875!

POLYSTACHYA MAURITIANA, *Spreng. Syst. Veg.* iii. (1826) 742. —P. zeylanica, *Lindl. Bot. Reg.* xxiv. (1838), *Misc.* p. 78.—Dendrobium polystachyum, *Thou. Orch. Iles Afr.* t. 85.

On the ground near Fort Dauphin, 2360! 2655!

Sprengel's name, which appears to have been overlooked by subsequent authors, is much older than that of Lindley. Both are based on Thouars's figure.

ANGRÆCUM SESQUIPEDALE, *Thou.*

Near Fianarantsoa, Interior, 2056! Forests, Ambahy, East Coast, 3042!

ANGRÆCUM SUPERBUM, *Thou.*

On old fallen wood or trees near Fort Dauphin, 2971! "*Tapaka tsy nelavoa*" of the natives.

ANGRÆCUM CITRATUM, *Thou.*

Forest near Ankeramadinika, 1880!

ANGRÆCUM ELLIOTII, *Rolfe*, sp. n.

Caulis elongatus, radicans. Folia disticha, alterna, 6–8 lin. distantia, linearia v. lanceolato-linearia, apice minute et acute biloba, $1\frac{1}{2}$–2 uncias longa, 3–4 lin. lata. Pedunculi uniflores, 1 unciam longi. Sepala lanceolata, subacuminata, posticum 4–5 lin. longum, $1\frac{1}{2}$ lin. latum, lateralia paullo angustiora. Petala similia, paullo breviora. Labellum late ovatum, concavum, longe acuminatum, 3–4 lin. longum, 2 lin. latum; calcari subclavato, 6–8 lin. longo. Columna brevis.

Forest near Angelampena, 2272!

Allied to the Mauritian *A. expansum*, Thouars, but with more acute and more distant leaves, among other differences. The short peduncles, which are really axillary, burst through the back of the sheathing base of the leaf, one or two from each node; the flower is borne from the axil of a lanceolate, acute bract, 2–$2\frac{1}{2}$ inches long, and there are one or two minute, obtuse sheathing bracts at the base of the peduncle. The roots are distichous, bursting through the leaf-sheaths, one above each peduncle, and serving to attach the plant to its support.

ANGRÆCUM GILPINÆ, *Reichb. f. et S. Moore in Journ. Linn. Soc., Bot.* xvi. (1877), p. 206.—Gussonia Gilpinæ, *Ridl. in Journ. Linn. Soc., Bot.* xxi. (1885), p. 491.

On trees in thickest part of forest near Fort Dauphin, 2653! "Flowers scarlet."

The specimens are finer than those previously collected; the largest raceme bears fourteen flowers. This belongs to a curious leafless section of the genus, but I do not see how it can be retained as a separate genus, unless *Angræcum* be further dismembered.

MYSTACIDIUM OCHRACEUM, *Ridl.*

Near Fort Dauphin?

MYSTACIDIUM DAUPHINENSE, *Rolfe*, sp. n.

Caulis erectus, subelongatus. Folia disticha, elongato-linearia,

inæqualiter biloba, 5–7 uncias longa, 3–5 lin. lata. Pedunculi graciles, 5–7-flori. Bracteæ reniformi-ovatæ, obtusæ, vaginatæ, $\frac{3}{4}$ lin. longæ, apice brevissime bilobo. Sepala lanceolata, subacuminata, 3 lin. longa. Petala paullo angustiora. Labellum late ovatum, valde concavum, petalis æquale; calcari subrecto subtereto, 3 lin. longo. Columna brevissima, alis descendentibus brevissimis carnosis truncatis.

On trees in forest near Fort Dauphin, 2499!

Allied to *M. caulescens*, Ridley, but with much longer leaves and other differences.

ŒONIA ELLIOTII, *Rolfe*, sp. n. (Plate XI.)

Caulis elongatus, radicans. Folia disticha, alterna, 6 lin. distantia, lineari-oblonga, obtusa v. inconspicue biloba, 1–1$\frac{1}{4}$ uncias longa, 3–4 lin. lata. Pedunculi erecti, 6–9 uncias longi. Racemi laxi, 3–5-flori. Flores mediocres, puberuli, albi. Bracteæ amplexicaules, late ovatæ, obtusæ, 1 lin. longæ. Sepala lanceolata, acuta, 6 lin. longa. Petala paullo latiora et obtusiora. Labellum trilobatum, 8 lin. longum; lobo medio obcordato 4 lin. lato; lateralibus minoribus rotundatis basi subcordatis; disco brevi-pubescente; calcari 2 lin. longo angusto basi saccato. Columna brevissima, apiculata, alis truncatis.

On trees near Fort Dauphin, 2842! 2843! "Flowers white."

In habit this species resembles *Œ. Auberti*, Lindl., and *Œ. rosea*, Ridley; the flowers much resembling those of the former, but only half as large and with a pubescent disc. The leaves are also narrower and more distant. *Œ. rosea* has flowers nearly as large as the present species, but the side-lobes of the lip are broader and the front one more deeply bilobed; the leaves are also much broader. The pollinarium in *Œ. Elliotii* is as follows:—Gland roundish-obovate, with a pair of erect adnate plates, which are very narrow below but gradually widen upwards to the apex, where are situated the two pollen-masses.

HOLOTHRIX GLABERRIMA, *Ridl.*

Rank grass near Mahobo, Lake Itasy, 1944.

HOLOTHRIX MADAGASCARIENSIS, *Rolfe*, sp. n.

Planta erecta, $\frac{1}{2}$–1 ped. alta. Folia 3–6, suberecta v. recurva, elongato-linearia, 3–6 uncias longa. Racemus secundus, densus, 2–5 uncias longus. Bracteæ anguste lanceolatæ, acuminatæ, 5–9 lin. longæ. Sepala anguste linearia, obtusa, 3 lin. longa, $\frac{1}{3}$

lin. lata. Petala subspathulato-linearia, obtusa, 4 lin. longa, 1 lin. lata. Labellum basi angustum, apice trilobatum, 4 lin. longum; lobis subspathulato-linearibus obtusis, 2 lin. longis; calcari brevi saccato. Columna brevissima, brevi-apiculata, alis lineari-oblongis obtusis; rostellum breve, indistincte trilobum, lobis lateralibus minutis.

Plains near Vaingaindrano, 2257! Near Fort Dauphin, 2643!

This species has much the habit of *H. glaberrima*, Ridley, but is readily distinguished by the more lax racemes of larger flowers, the much larger side-lobes of the lip, and the very short saccate spur.

Bicornella gracilis, *Lindl.*

On grassy alluvial plains, Moromonga, Tamatave to Capital, 1759! Amongst grass near Antananarivo, 1808! "Flowers purple." Near interior boundary of forest, Angalampena, 2113! "Flowers pink."

Bicornella parviflora, *Ridl.*

Fianarantsoa, 2058!

Habenaria spiralis, *Ridl.*

On the top of Ankaratra Mountains, 1982! Grassy highlands, Ankaratra, 2096!

Habenaria dauphinensis, *Rolfe*, sp. n.

Planta circa $1\frac{1}{2}$ ped. alta. Folia elongato-linearia, 6 uncias longa, 3 lin. lata. Racemus laxus, multiflorus. Flores virides. Bracteæ lanceolatæ, acuminatæ, 2 lin. longæ. Sepala late elliptico-oblonga, obtusissima, $\frac{3}{4}$ lin. longa; sepalum posticum concavum. Petala subsimilia, subæqualia, carnosula. Labellum valde concavum, carnosulum, obscure trilobatum; lobis lateralibus rotundatis, medio obtusissimo; calcari lato compresso truncato v. brevissime emarginato, $\frac{3}{4}$ lin. longo. Columna brevissima, apiculata; stigmata minutissima.

On the ground near Fort Dauphin, 2867.

This species is allied to *H. minutiflora*, Ridl., but is readily distinguished by the shorter segments, less divided lip, and the longer flattened and almost bidentate spur.

Habenaria nutans, *Thou.*

Near Fort Dauphin?

HABENARIA TRUNCATA, *Lindl.*
Marshy place, red clay (débris, granite), Mahobo, Lake Itasy, 1919.

HABENARIA HILSENBERGII, *Ridl.*
Among long grass in rather moist places, red clay (débris, granite), Mahobo, Lake Itasy, 1920! Near Angelampena, 2118!

HABENARIA INCARNATA, *Reichb. f.*
Near Fort Dauphin, 2576!

HABENARIA CIRRHATA, *Lindl.*
Wet places (volcanic soil) on Ankaratra Mountains (Interior), 1957!

HABENARIA DISOIDES, *Ridl.*
Among grass on tops of Ankaratra Mountains (Interior), 1969!

HABENARIA ELLIOTII, *Rolfe*, sp. n. (Plate XII.)
Planta $1\frac{1}{2}$–2 ped. alta. Folia numerosa, lanceolata, acuta, 3–5 uncias longa, $\frac{3}{4}$–$1\frac{1}{4}$ lata. Racemus laxus, 6–10 uncias longus, multiflorus. Bracteæ lanceolatæ v. lineari-lanceolatæ, acuminatæ, $\frac{1}{2}$–1 unciam longa. Sepalum dorsale ovatum, subacutum, 3 lin. longum; lateralia oblique lanceolata, subacuminata, 4 lin. longa. Petala profunde bifida, lobis 3 lin. longis, angustissimis. Labellum profunde trilobatum; lobis angustissimis, lobo medio 5 lin. longo, lateralibus 9 lin. longis; calcari gracillimo, apice subclavato, $1\frac{3}{4}$–2 uncias longo. Columna brevis; antheræ apices breves, recti, subobtusi; stigmata subclavata, 1 lin. longa.
Wet marshy slope near A'Mpanjaka, Manandona, Interior, 2004! Wet marshy places, open country, Fianarantsoa, 2037! Grassy plain near Betsiraha, East Coast, 2219! "*Sinananga*" of the natives. Without precise locality, *Humblot* 669!
This species has much of the general aspect of *H. Foxii*, Ridley, to which it is obviously allied; but the lobes of the lip and petals are much longer, and the spur three times as long as in that species.

CYNORCHIS GIBBOSA, *Ridl.*
Open grassy country, Fianarantsoa, 2055!

Cynorchis elata, *Rolfe*, sp. n.

Planta $\frac{1}{2}$–1 ped. alta, glabra. Folia 2 radicalia, breviter petiolata, elliptico-oblonga, subacuta v. obtusa, $1\frac{1}{2}$–$3\frac{1}{2}$ uncias longa, $\frac{3}{4}$–$1\frac{1}{2}$ lata. Racemus laxus, 1–4 uncias longus, pauci–20-florus. Bracteæ ovato-lanceolatæ, acutæ, 2–3 lin. longæ. Sepalum posticum galeatum, ovatum, obtusum, $2\frac{1}{2}$ lin. longum; lateralia late obovata, 2 lin. lata. Petala subfalcato-linearia, obtusa. Labellum trilobatum; lobis lateralibus oblongis obtusis, medio angustiore lineari obtuso; calcari elongato, 6 lin. longo. Columna brevis; antheræ apices elongati; rostellum latum.

On humus in woods near Fort Dauphin, 2477!

A very distinct species, somewhat allied to *C. lilacina*, Ridley, but quite glabrous, and not easily confounded with any other.

Cynorchis Baronii, *Rolfe*, sp. n.

Planta 4–9 uncias alta, pubescentia. Folia 2 radicalia, decumbentia, ovata v. ovato-lanceolata, acuta, 1–2 uncias longa, 4–10 lin. lata. Racemus laxus, 1–3 uncias longus. Flores puberuli. Bracteæ anguste lanceolatæ, acuminatæ, 2–4 lin. longæ. Sepalum posticum ovatum, obtusum, $1\frac{1}{2}$ lin. longum; lateralia majora, subobliqua. Petala multo angustiora, subobliqua. Labellum 2 lin. longum, apice trilobatum; lobis oblongis obtusis, medio quam lateralibus longiore; calcari $1\frac{1}{2}$ lin. longo, obtuso. Columna brevissima; antheræ apices breves; rostellum breve, acutum; stigmata brevia, clavata.

Shady places on humus on summit of Andringitra Mountains, Interior, 1853! Central Madagascar, *Baron* 725! North-west Madagascar?, *Baron* 5246!

Much smaller than *C. lilacina*, Ridley, to which it is obviously allied.

Cynorchis pauciflora, *Rolfe*, sp. n.

Planta 4–5 uncias alta, pubescentia. Folia radicalia non vidi, caulina ovato-lanceolata, breviter acuminata. Racemus brevis, laxus. Flores puberuli. Bracteæ lanceolatæ, acuminatæ, 3–4 lin. longæ. Sepalum posticum ovatum, obtusum, $1\frac{1}{2}$ lin. longum; lateralia paullo majora, subobliqua. Petala similia paullo minora. Labellum 2 lin. longum, apice trilobatum; lobis oblongis obtusis subæqualibus; calcari 1 lin. longo, obtuso. Columna brevissima; antheræ apices breves; rostellum parvum; stigmata suclavata.

Rather wet places on top of Ankaratra Mountains, 8000 or 9000 feet, 1983!

Allied to the preceding, but with broader segments, more obtuse lobes to the lip, and other characters. The radical leaves appear to be wanting, but the cauline ones (two on one specimen, and one on each of the two others) vary from $\frac{1}{4}$ to $1\frac{1}{4}$ inches long and from 2 to 6 lines wide.

SATYRIUM ROSTRATUM, *Lindl.*

Hillsides and wet places near Ankaratra Mountains, Interior, 1955!

S. giganteum, Ridl. (Journ. Linn. Soc., Bot. xxii. p. 126), seems quite identical with Lindley's plant, which may have been overlooked when the former was described. I have carefully dissected a flower from each of the type specimens, side by side, and cannot detect any difference between them, while in stature and general appearance they are also indistinguishable.

SATYRIUM TRINERVE, *Lindl.*

Near pools of water (alluvial), Moromonga plain, Tamatave to Capital, 1757! Near water, Arivonimamo, 1929!

SATYRIUM AMŒNUM, *A. Rich.*

On tops of Ankaratra Mountains, Interior, 1981!

DISA INCARNATA, *Lindl.*

Near streams, Arivonimamo, Lake Itasy, 1940!

DISA BUCHENAVIANA, *Kranzlin.*

Wet places in rank grass at 4500–5000 feet on the Andringitra Mountains, Interior, 1832! "Flowers bluish purple."

DISPERIS TRIPETALOIDEA, *Lindl.*

On humus in woods near Fort Dauphin, 2305!, 2731!

IRIDEÆ.

GEISSORHIZA BOJERI, *Baker.*

Capsule obovate-oblong, 1–3 cm. long and 6 mm. broad. (The narrow cylindrical form of the capsules in Parker's specimen (Herb. Kew) is therefore probably abnormal: *cf.* Benth. & Hook. f. Gen. Plant. vol. iii. p. 703.)

Ankaratra Mountains, 2092!

AMARYLLIDEÆ.

HYPOXIS ANGUSTIFOLIA, *Lam.*

Several localities, 2547! 2195! 2447! 1818! The last number contains specimens only about 3 inches high, while some of the others reach 18 inches.

LILIACEÆ.

ALOE BAKERI, sp. n.

Subacaulis, foliis 15–20 rosulatis ad apicem gradatim attenuatis recurvis facie subplanis dorso convexis, margine corneo denticulis parvis ornato, racemis simplicibus 6–8-floris, pedicellis pendulis, floribus rubellis, perianthio tubuloso vel subobovato, segmentis brevibus obtusis, genitaliis inclusis perianthium æquantibus, capsula elliptica.

Leaves 7–9 cm. long and 1 cm. broad at base; denticles straight or slightly curved, about 1 mm. in height. Peduncle 30 cm.; bracts 2–3 mm. long, scarious; pedicels on the last 2–3 cm. of the stalk usually about 1–2 cm. long. Perianth red, quite glabrous, 2 cm. long and 8 mm. broad; segments short (5 mm.), obtuse, marked by 3–5 black nerves converging at the tip. Filaments flattened; anthers 3 mm. long. Style simple. Capsule ellipsoidal, 1·2 cm. long and 6 mm. broad.

Sand-dunes, Fort Dauphin, 2937!

Near *A. aristata*, Baker.

ASPARAGUS ASIATICUS, *L.*, var. nov. PAUCIFLORA; inermis, cladodiis sæpius 3nis, floribus solitariis v. binis, baccis rubris, paucispermis, seminibus magnis nigris tuberculatis.

In woods near Fort Dauphin, 2343! also 2318!

DRACÆNA BAKERI, sp. n.

D. trunco elato subscandente, foliis reflexis vel subascendentibus lineari-lanceolatis acutis apiculatis rigidis subtus costatis margine valde revoluto, paniculis simplicibus terminalibus, pedicellis ascendentibus infra medium articulatis, bracteis parvis ovatis acutis membranaceis, baccis rubris 1–3-spermis.

The younger flowering branches about 2 mm. thick. Leaves 2·5–5 cm. long and 3–5 mm. broad. Panicle about 12 cm. long and when expanded about 4–5 cm. across; pedicels 1·5 cm. long, with articulation about 5 mm. from the base. Bracts ovate, acuminate, 2–3 mm. long. Berry, if one-seeded, about 7 mm. in diameter.

Woods near Fort Dauphin, 2426! 2439!

DIOSCOREÆ.

DIOSCOREA LUCIDA, sp. n.

D. ramis volubilibus striatis pubescentibus vel sæpius subglabris, foliis variis glabris 3–5-foliolatis, foliolis lanceolatis acuminatis

petiolulatis vel foliolis lateralibus ad basin externe cordatis, cymis *masculis* brevissime pedunculatis 5–6nis pendulis, pedicellis brevibus bracteas lineares æquantibus, rhachilla pedicellisque villosis, perianthii segmentis ovatis interioribus quam exteriores latioribus, spicis *femineis* solitariis, staminum rudimentis (? nectarialibus) sessilibus, ovario villoso 3-sulcato, fructu maturo reflexo 3-alato, alis magnis orbicularibus glabris lucidis, margine incrassato, seminibus circumcirca ala membranacea cinctis.

A climber with glabrous or very loosely hairy stems. Leaves glabrous except for a tuft of white hairs in the axils; petiole 3–5 cm. long; terminal leaflet 5–7 cm. long and 2–3 cm. broad. Cymes 6–12 cm. long; pedicels 2–3 mm. and 1–2-flowered. Wings of fruit 2 cm. long and 1·5 cm. in breadth; membranous ring of seed nearly 5 mm. in diameter.

Climbing amongst bushes, Fort Dauphin, 2624!

PALMEÆ.

(By Dr. O. Beccari.)

Phloga Scottiana, *Becc.*, sp. n.

Gracillima, caudice ($\pm$ 6 mill. crasso) crebre cicatricoso-annulato; frondium vagina tubulosa longitudinaliter nervoso-striata, apice subtruncata, ibique brevissime fissa et biauriculata, fugacissime griseo- vel fusco-furfuracea; petiolo gracili 4–5 cent. longo, longitudinaliter striato, subtriquetro, supra planiusculo vel superficialiter canaliculato; limbo $\pm$ ·25 cent. longo, crebre interrupteque vel subregulariter pinnatisecto, segmentis planis (non plicatis) subtiliter chartaceis, 8–10 cent. longis, 6–10 mill. latis, angustissime lanceolatis, apice sensim acuminatis, basi paullo attenuatis, glabris, costa media acuta percursis, subtus pallidioribus et non paleosis, nervis lateralibus et marginantibus tenuibus, venulis transversis inconspicuis; spadice gracili frondibus breviore, alterne remoteque parce ramoso, ramulis florigenis gracillimis, filiformibus, brevibus, paucifloris; spathis 2, vaginantibus, quarum exterior brevissima, interior valde elongata et angustissima, membranaceo-exsucca, compressa, acute bicarinata, infra apicem fissa; floribus minutis, masculis symmetris, oblongis, obtusis, $2\frac{1}{4}$ mill. longis, $1\frac{3}{4}$ mill. latis, staminibus 6, antheris oblongo-sagittatis, ovarii rudimento ovato-oblongo, fl. fœmineis ovato-conicis, corolla calyce subduplo longiore, ovario oblongo, stigmate 3-dentato, staminum rudimentis 6; fructibus . . . .

Forest near Fort Dauphin, 2615!

Phloga polystachya, *Noronha, MSS.* — Dypsis nodifera, *Mart. Hist. Nat. Palm.* iii. p. 312.

Fort Dauphin, 2419!

XYRIDEÆ.

Xyris Bakeri, *Nilss. in Öfv. Vet. Ak. Förhandl.* (1891) 157.

X. foliis elongatis 6-nerviis rigidis ad basin latis persistentibus, capitulo longe cylindraceo, bracteis duabus inferioribus connatis ovatis subacutis ceteris rotundato-ovatis mucronulatis dorso areola puncticulata notatis glabris, perianthii segmentis obtusis obovatis ad faucem interne dense villosis, antheris oblongis.

Leaves 2 feet or more in length and about 3 mm. broad, sheathing at base. Scapes 2–3 feet high. Capitula 1·5–2·5 cm. long; bracts densely overlapping, with an apparently pubescent areola near tip and ending in a small blunt mucro; usually 6 mm. long and 4–5 mm. broad. Perianth-segments 6–9 mm. long and 4 mm. broad. Filaments short; anthers parallel, oblong. Style-branches bilobed at extremity.

Baron 1025! 568! Marshy alluvial meadows, Fort Dauphin, *Scott Elliot* 2915!

This form is quite distinct from *X. capensis*, Thunberg, with which it has been mixed in the Kew Herbarium. *Cf.* Thunberg 'Flora Capensis,' p. 310: "Capitulo ovato, foliis linearibus brevissimis; limbi (perianthii) laciniæ ovatæ lineam longæ; antheræ ovatæ."

CYPERACEÆ.

(By Mr. C. B. Clarke, F.R.S.)

Carex alboviridis, *C. B. Clarke*, sp. n.

Panicula composita, ramis longius pedunculatis distantibus; spiculis ovoideis, laxis androgynis, apice masculis; glumis cum utriculis subæquilongis, triangulari-caudatis, scarioso-albidis, in carina viridibus; rostro cum $\frac{1}{2}$ parte utriculi subæquilongo, compresso, altius bifido, scarioso viridi, parce hispido-scabro; stylo trifido.

Rhizoma longe repens, tenue, ligneum, e stolone exortum. Culmus 5 dm. longus, pauci-nodosus. Folia (imo basalia) culmum superantia, angusta, apice longe acuminata hispido-scabra. Bracteæ foliis similes; harum vaginæ usque ad 2–4 cm. longæ. Panicula 3 dm. longa, fere glabra, in parte superiore minute hispido-scabra. Pedunculi usque ad 1 dm. longi, graciles, 5–10-

spiculigeri. Spiculæ subspicatæ 1 cm. longæ, 5–10-utriculiferæ. Glumæ femineæ 4 mm. longæ, fere glabræ; masculæ angustiores proventu pallide ferrugineæ. Utriculi 4 mm. longi ellipsoidei, trigoni, vix curvati, in rostrum suboblongum subito angustati, fere glabri conspicue 16–20-striati, virides. Nux cum utriculo conformis in verbis caricologorum puncticulata. *Caricis Hildebrandtianæ*, Boeck. (Engler's Jahrb. v. p. 516), var. evoluta sed multo robustior, panicula majore, spiculis majoribus, glumis femineis duplo longioribus, utriculis majoribus minus curvatis multo magis striatis rostro breviore. *C. polycephalæ*, Boott, sat affinis, sed spiculæ minus elongatæ rostrum multo brevius.

Dry sandy dunes, Fort Dauphin, 2534!

COSTULARIA RECURVA, *C. B. Clarke.*
Glades in forest, Ankeramadinika, 1777!

FIMBRISTYLIS CINEREA, *Ridl.*
Near Antananarivo, short turf, 1734!

GRAMINEÆ.
(By Prof. HACKEL.)

PANICUM (§ DIGITARIA) ATROFUSCUM, *Hackel.*

Racemis circ. quaternis approximato-alternis demum divergentibus, rhachi de spiculis angustiore pedicellisque glabra, scabra, spiculis lanceolato-ellipticis vix 2 mm. longis, gluma 1ma nulla, 2da quam spicula triplo breviore obtusa trinervi, 3a spiculam æquante acutiuscula 7-nervi, omnibus glabris, 4a demum atrofusca minutissime puncticulato-scabra. Culmi elatiores. Folia linearia, glabra. Racemi circ. 10 cm. longi.

Proximum *P. phæocarpo*, Nees, quod differt gluma 2da quam spiculi paullo breviore cum 3a inter nervos puberula.

P. diagonali, Nees, etiam affine, differt racemis crebris paniculatis erecto patulis, rhachi de longe pilosa, gluma 3a trinervi.

Marshy valley, Lake Itasy (Interior), 1909!

PANICUM (§ BRACHIARIA) SCOTTII, sp. n.

Culmo erecto ramoso, foliis linearibus acutis, racemis 4–6, interstitia subæquantibus v. æquantibus, appressis, brevibus, rhachi de glabra, scabra, spiculis solitariis v. in rhachidis basi binis ternisve brevissime pedicellatis ovalibus obtusis, hinc gibbis, glabris; glumis sterilibus obtusis: 1ma suborbiculari spicula dimidia breviore, 2a spicula paullo breviore, 3a hanc æquante florem ♂ fovente, 4a spiculam æquante puncticulato-scabra.

Perenne, gracile, ramis floriferis elongatis, folia supra pilis mollissimis conspersa. Racemi 1–1·5 cm. longi in paniculam linearem dispositi. Spiculæ viridulæ glabræ; gluma 1ma enervis, 2da et 3a 5-nerves.

Affine *P. arabico*, Nees, quod differt culmo repente, foliis glabris, racemis quam interstitia brevioribus, gluma 4na læviuscula.

Dry hills of Imerina, 1810!

PANICUM (§ ECHINOCHLOA) HISPIDULUM, *Retz.*

I think a variety of *P. Crus-Galli*, L. Betsiraha, 2224!

PANICUM (§ EUPANICUM) LURIDUM, sp. n.

Culmo decumbente ascendente, foliis inferne aggregatis, ligula ciliari, laminis lineari-lanceolatis basi ciliatis rigidulis; panicula obovata laxiuscula; pedicellis quam spiculæ longioribus glabris; spiculis 2 mm. longis ovalibus obtusis glabris; gluma 1ma spiculæ medium subæquante, 3a florem ♂ fovente obtusa, 4a oblonga obtusa nitida.

Culmi (parte erecta) vix 20 cm. alti, superne subramosi. Laminæ circ. 3 cm. longæ 4 mm. latæ, pilis parcis adspersæ. Paniculæ rami solitarii, ramulosi, ramulis flexuosis scabris. Spiculæ luridæ violascenti-variegatæ; gluma 1ma 1-nervis, 2da et 3na ovales, obtusæ, 5-nerves, 4a spiculam subæquans flavida.

Affine *P. umbellato*, Trin., quod differt culmo longe repente valde ramoso, spiculis ellipticis acutis, glumis acutis, 1ma parvula.

Common near Antananarivo, 1745!

PANICUM (§ EUPANICUM) DELTOIDEUM, sp. n.

Humile, decumbens, culmo ramoso polyphyllo, vaginis pilosis ad nodos reflexo-barbatis, laminis parvis ellipticis brevi-acuminatis parce pilosis, panicula laxa obovata ramis ramulosis laxifloris capillaribus scabris, spiculis *subtrigonis* a latere compressis glabris, gluma 1ma spiculæ duas partes æquante, 4a valde gibba apiculata puncticulata.

Laminæ 10–18 mm. longæ, 5–8 mm. latæ, basi cum vaginis patenti-pilosæ. Spiculæ livide virides; glumæ 1ma, 2da, 3na tenues, membranaceæ, 3-nerves, obtusæ.

Affine *P. trigono*, Retz., quod differt foliis angustis lineari-lanceolatis glabris, multo longioribus, panicula multiflora, spiculis hispidis.

Shady hollow, Manandona Valley, 2009 *b*!

Isachne Mauritiana, *Kunth*, var. hispidula (differt a typica glumis sterilibus superne hispidulis).

Fort Dauphin, 2813 !

Pennisetum Alopecuros, *Steud.*

I cannot distinguish this specifically from the East-Indian type, though the latter is more robust*.

Canal-banks near Antananarivo, 1730 ! 1731 !

Sporobolus subulatus, sp. n.

Differt a proximo *Sp. fimbriato*, Nees, paniculæ ramis basi breviter nudis, spiculis fere duplo majoribus (3·5–4 mm. longis), fere subulato-lanceolatis, gluma sterili inferiore lineari spiculæ $\frac{2}{3}$–$\frac{3}{4}$ subæquante.

Dry gneiss hills of Betsileo, alluvium Vaingaindrano, 2034 ! 2260 ! 3052 !

Agrostis Elliotii, sp. n.

A. foliis linearibus planis acuminatis supra scabris, ligula oblonga truncata, panicula lineari-coarctata densissima subinterrupta vaginata, ramis appressis a basi floriferis, spiculis imbricatis subsessilibus 4 mm. longis, lineari-lanceolatis pallide viridibus; glumis sterilibus subæqualibus, lineari-lanceolatis rigidulis, scaberrimis, 1ma acuta, 2da infra apicem mucronulata, gluma florifera sterilibus paullo breviore, hyalina, bimucronulata, glabra, supra basin exserens aristam subuliformem supra medium geniculatam glumas non superantem. Palea nulla.

Remote affinis *A. hygrometricæ*, Nees, quæ differt paniculæ ramis 3nis–5nis, gluma 2da non mucronulata, floriferæ arista quam gluma duplo longiore valde torta.

Ankaratra Mountains, also Fort Dauphin, 2090 ! 2921 !

Trichopteryx stipoides, *Hack.*, =Arundinella stipoides, *Hack.*, =Stipa madagascariensis, *Baker.*

Manandona valley, 2003 !

Centotheca, subgen. Megastachya.

(Megastachya, *Beauv. Agrostogr.*, non aliorum.)

Differt a *Centotheca* propria spiculis multifloris, glumis fertilibus apice plus minus emarginatis ex emarginatura sæpius mucronulatis. (*Conf.* Benth. et Hook. f. Gen. Plant. iii. p. 1190.)

* This form =*P. triticoides*, Baker, Journ. Linn. Soc. xxi. p. 453.—*G. F. S. E.*

Habitus *Eragrostidis* sed differt glumis fertilibus 7-nerviis, foliis lanceolatis etc.

CENTOTHECA MUCRONATA, *Hack.* (Poa mucronata, *Beauv. Fl. Ow.*—Megastachya owariensis, *Beauv. Agrost.* t. 15. f. 5.)

Laminis e basi late cordata amplexicauli lanceolatis, margine undulatis, spiculis lateralibus pedicello suo 3–5plo longioribus, glumis fertilibus distincte emarginatis et mucronatis.

Often in or near woods, Fort Dauphin, 3054! 2309 *b*! 2936! 2502 *b*!

CENTOTHECA MADAGASCARIENSIS, *Hack.* (? Poa madagascariensis, *Lam.*)

C. laminis e basi rotundata non amplectente lineari-lanceolatis, margine rectis; spiculis omnibus longissime pedicellatis (quam pedicellis 2–6plo longioribus), glumis fertilibus obsolete emarginatis mucronulatisque.

Shady places, Fort Dauphin, 2502 *a*! 2766! 2935!

EXPLANATION OF THE PLATES.

PLATE I.

Sphærosepalum coriaceum.

Fig. 1. Flower viewed from above. 2. Flower in median vertical section. 3. Stamens.

PLATE II.

Quivisia grandifolia.

Fig. 1. Flower from outside. 2. End of staminal tube, with free stamens ending in barren tips. 3. Ovary, style, and stigma.

PLATE III.

Kalanchoë verticillata.

Fig. 1. Flower from exterior (corolla being opened along one side). 2. Stamens. 3. Extremity of leaf seen from below. 4. The same from above.

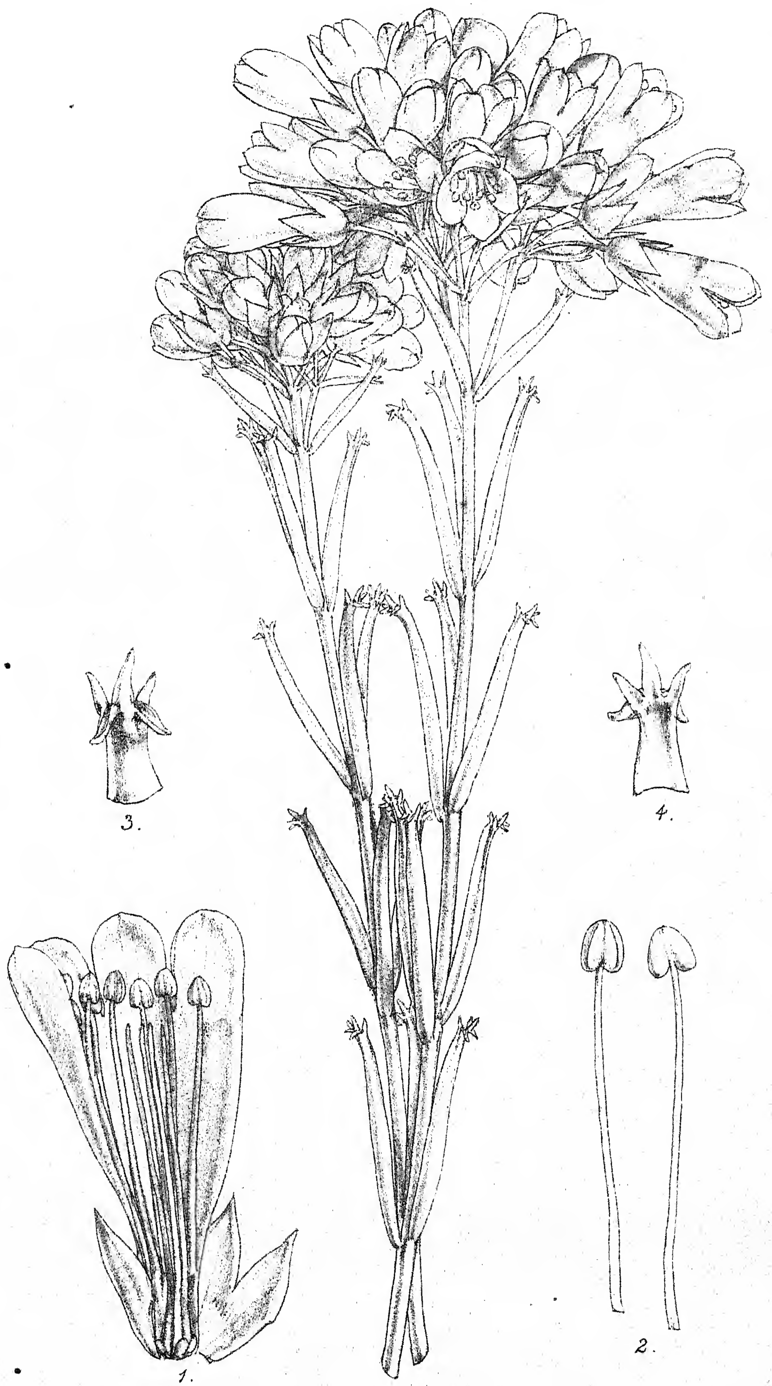
PLATE IV.

Osbeckia Elliotii.

Fig. 1. Flower in longitudinal median section. 2. Ovule (enlarged). 3. Stamens.

C. Fitch del.　　SPHÆROSEPALUM CORIACEUM.　　Hanhart lith.

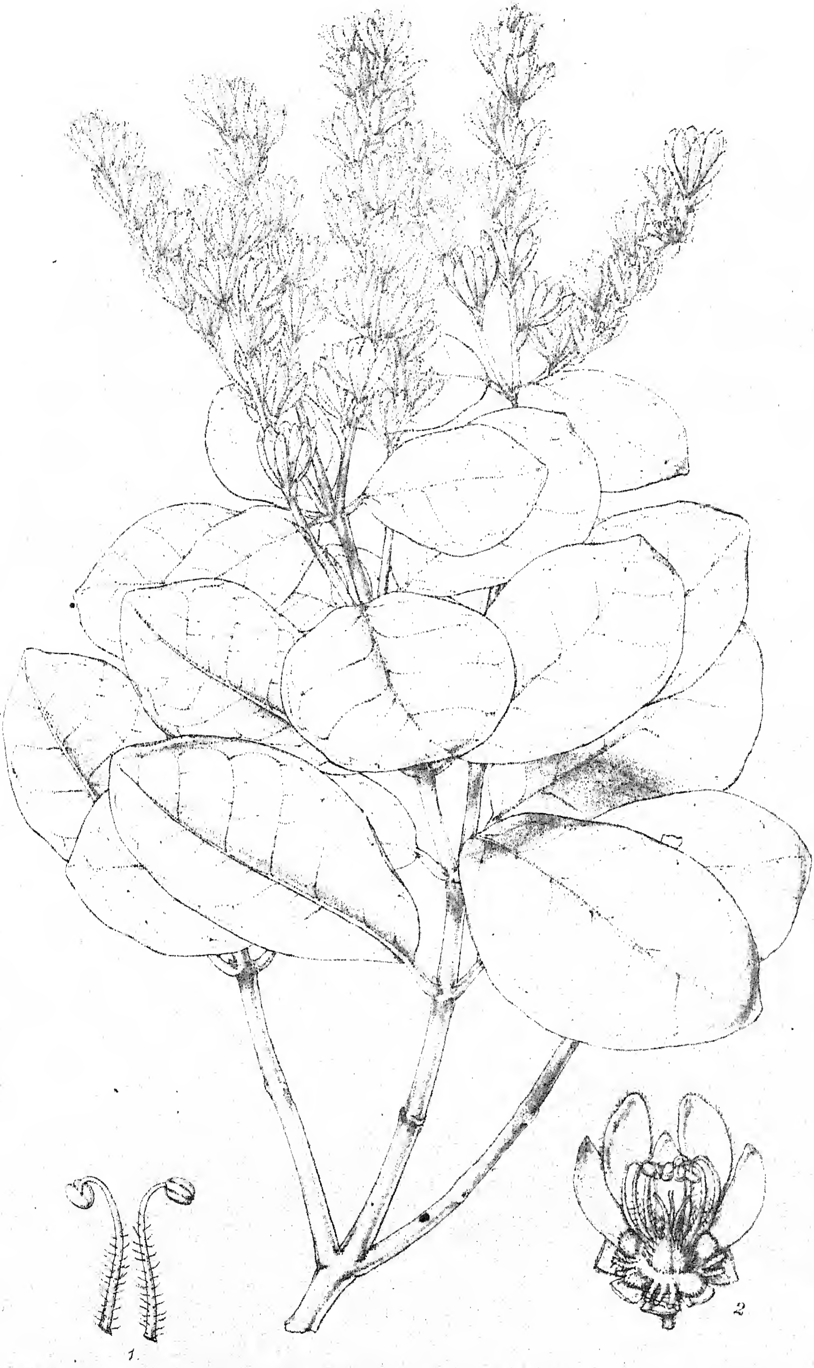
C. Fitch del. QUIVISIA GRANDIFOLIA. Hanhart lith.



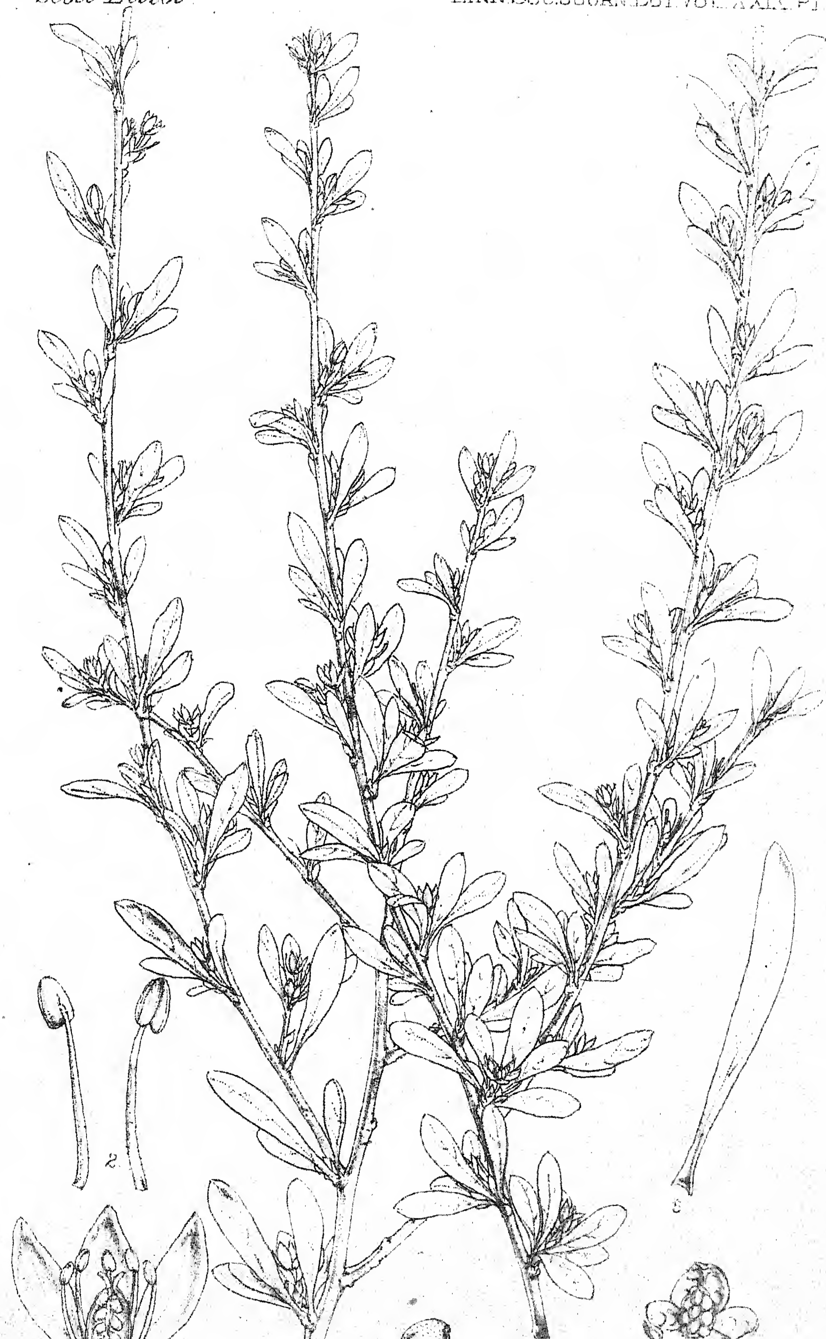
C. Fitch del. KALANCHOE VERTICILLATA. Hanhart lith.

C. Fitch del. OSBECKIA ELLIOTII. Hanhart lith.

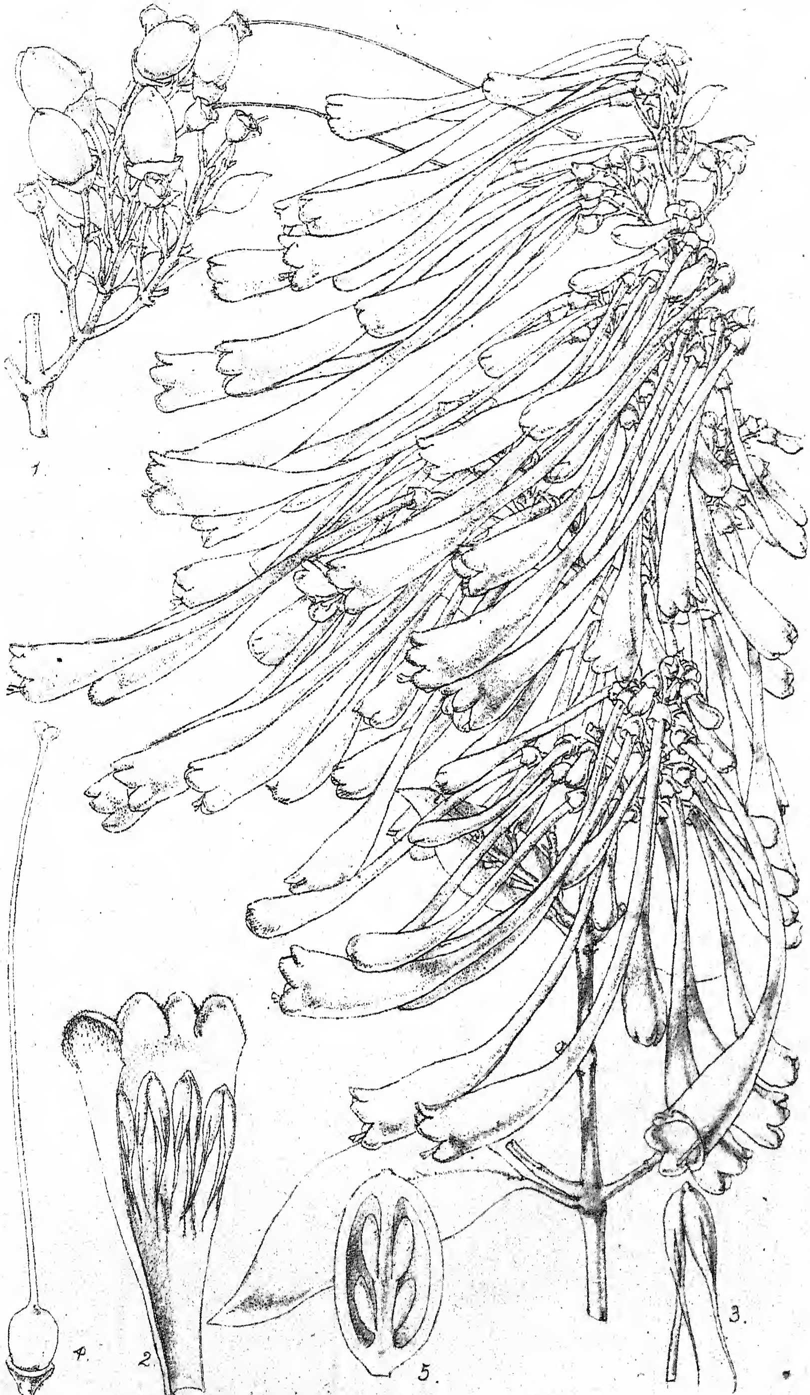
C. Fitch del. CALANTICA LUCIDA. Hanhart lith.



C. Fitch del. HOMALIUM CYMOSULUM. Hanhart lith.



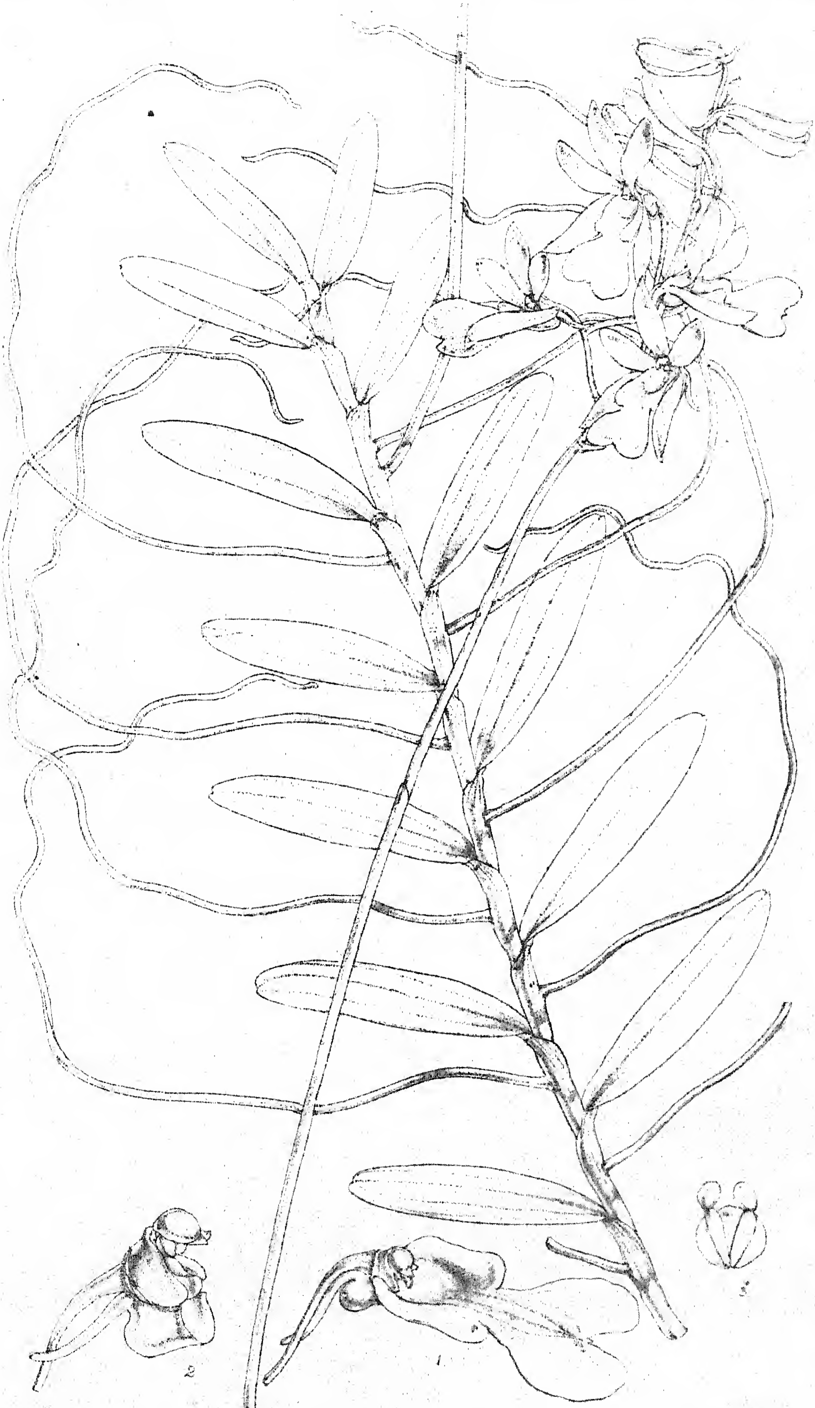
C. Fitch del.   MOLLUGO CÆSPITOSA.   Hanhart lith.



C. Fitch del. LEUCOSALPA MADAGASCARIENSIS. Hanhart lith.

C. Fitch del.   COLEA COCCINEA.   Hanhart lith.

C. Fitch del. CAMAROTEA SOUIENSIS Hanhart lith.



C Fitch del. ŒONIA ELLIOTII Hanhart lith.

C. Fitch del. HABENARIA ELLIOTII. Hanhart lith.

PLATE V.

Calantica lucida.

Fig. 1. Flower in longitudinal vertical section. 2. Stamens.

PLATE VI.

Homalium cymosulum.

Fig. 1. Flower seen obliquely from above, with part of calyx, corolla, and andrœcium removed. 2. Stamens.

PLATE VII.

Mollugo cæspitosa.

Fig. 1. Flower in longitudinal median section. 2. Stamen. 3. Capsule when dehiscing. 4. Ovule. 5. Leaf.

PLATE VIII.

Leucosalpa madagascariensis.

Fig. 1. Secondary axis of inflorescence in fruit. 2. Corolla opened to show insertion of stamens. 3. Stamen (to show anther-tails). 4. Ovary, style, and stigma. 5. Longitudinal median section of ovary.

PLATE IX.

Colea coccinea.

Fig. 1. Corolla opened along lower edge. 2. Stamens. 3. Ovary, nectarial ring, style, and stigma.

PLATE X.

Camarotea souiensis.

Fig. 1. Corolla opened to show insertion of stamens. 2. Ovary, nectarial ring, style, and stigma. 3. Stamens. 4. Longitudinal section of ovary.

PLATE XI.

Æonia Elliotii.

Fig. 1. Flower, with labellum (the rest of the perianth removed). 2. Spur of labellum and clinandrium slightly raised to show pollinia. 3. Pollinium.

PLATE XII.

Holothrix madagascariensis.

(Lettered *Habenaria Elliotti* by error.)

Fig. 1. Entire flower. 2. Column and basal part of labellum.

On the Structure and Development of the Cystocarps of *Catenella Opuntia*, Grev. By R. J. Harvey Gibson, M.A., F.L.S., F.R.S.E., Lecturer on Botany in University College, Liverpool.

[Read 18th December, 1890.]

(Plates XIII. & XIV.)

The classification of Algæ is a subject on which systematists are very far from being unanimous; and this is especially due to the fact that we are ignorant in very many cases of the structure of the reproductive organs of type forms, chiefly among the Rhodophyceæ.

The alga, the structure of whose fruits forms the subject of the present paper, common as it is on our shores, is a striking example of the difficulty of classifying a member of the group Florideæ on vegetative characters alone. As long ago as 1830 Greville * wrote :—"The peculiarity of the internal structure of this alga has induced me to separate it from all others, even in the absence of fructification, and, in conjunction with its habit, to place it amongst the Gastrocarpeæ. It has ever been considered in the light of a doubtful plant, and has successively held the title of *Ulva*, *Fucus*, *Rivularia*, *Gigartina*, *Chondria*, *Halymenia*, *Lomentaria*, and, lastly, *mirabile dictu*, of *Chordaria* in Sprengel's 'Systema Vegetabilium'! I have endeavoured—not, I think, without sufficient cause—to afford this almost universal trespasser something more like a 'local habitation and a name.'"

The cystocarps of *Catenella Opuntia* have hitherto remained almost an unknown quantity. Goodenough and Woodward †, after describing the articulations as oval, say "quorum supremi tuberculorum officio funguntur, et seminibus minutissimis congestis foeti sunt." It is difficult to say from this description and from their figures whether these modified articulations were tetrasporic or cystocarpic, although in all probability they were the former.

Greville ‡ affirms that the fructification was unknown in his day; but he adds that Lightfoot believed that the joints of the frond were the situations where "minute seeds" were to be

* 'Algæ Britannicæ,' p. 166.
† Trans. Linn. Soc. vol. iii. p. 219.
‡ *Loc. cit.* p. 167.

found; that Sir J. E. Smith considered the smaller joints of the internal filaments to be reproductive in function; lastly, that Dawson Turner observed minute black bodies on the frond which he believed to represent a fructification. Turner, however, merely quotes Goodenough and Woodward's observations, adding "a circumstance I have never had the opportunity of remarking" *. None of these appearances Greville considered to be of the nature of true fructifications.

Harvey † says that the species is rarely found in fruit, but that cystocarps had been given to him by Mrs. Griffiths. He describes them in the following terms:—"Fructification: 1, spherical masses of spores or *favellidæ* contained in ovate capsules, furnished with a terminal pore, their walls formed of moniliform filaments. The mass of spores appears to be formed by a transformation of the internal network." Harvey figures a cystocarp in longitudinal section, showing an ovate capsule with a well-marked terminal pore, an intracapsular space, and a spherical mass of carpospores. In fact, his figure closely resembles that of a cystocarp of a *Polysiphonia*, from which, as will be shown, the cystocarp differs as widely as possible.

The figure given by Crouan ‡ is equally wide of the mark in detail, though a terminal pore is not figured.

J. G. Agardh § describes the cystocarps of the genus *Catenella* as being immersed in branches, but doubts their having open terminal pores. He describes their structure in the following terms:—". . . . nucleum ad fila longitudinalia suspensum subcompositum foventia; nucleus placentari adparatu centrali subdivisus, fasciculos filorum prægnantium, peripheriam versus radiantes sterilibus filiis a placenta ad fila peripherica extensis interceptos emittens; gemmidia in filis radiantibus pauca oblongo-obovata." Agardh adds that his personal acquaintance with the cystocarps of *Catenella Opuntia* was confined to one small specimen.

Hauck ‖ cautiously avoids reference to the fruit as described by earlier observers, and says:—"Cystocarpien bei *C. Opuntia* nicht genügend bekannt."

* 'Synop. Brit. Fuci,' 1802, p. 388.
† 'Phycologia Britannica,' pl. lxxxviii.
‡ 'Florule Finist.' tab. 16. fig. 108.
§ 'Epicrisis System. Florid.' p. 586.
‖ 'Meeresalgen,' p. 186.

Dr. Bornet informs me that he has never met with this rarity; and my friend Mr. Batters has been equally unfortunate. Mr. Buffham * mentions having seen them, but he gives no description or figure. In a private letter Mr. Buffham informs me that the material he collected was monœcious, but that he hesitated to describe the structure of the cystocarp in detail, not only because he had taken but little material, but also because the appearances seemed to him "so extraordinary."

Dr. Bornet mentioned in his letter to me that Prof. Schmitz had, he believed, examined specimens with cystocarps; and I accordingly entered into correspondence with that distinguished algologist. Dr. Schmitz was so kind as to furnish me with notes of his unpublished observations on specimens he had obtained from the Berlin Herbarium in 1885, gathered on the coast of Normandy, and at Ostend in the year 1832. I have to record my thanks to Prof. Schmitz, not only for these notes, but also for various critical remarks made on my MS. and drawings which he was good enough to look over. These criticisms I shall have occasion to refer to in the sequel.

The structure of the vegetative organs has been frequently described in many treatises; I may briefly recapitulate the chief features of that structure, as it will be thus more easy to elucidate that of the reproductive organs. The antheridia have been already figured by Buffham, and the tetraspores by Kützing and others. I add a few notes on these organs, which my sections enabled me to make out more clearly.

Following the advice given to me by Mr. E. A. L. Batters, I have gathered (or had sent to me) regularly for many months a number of plants of *C. Opuntia*, in the hope that I might meet with specimens of the cystocarpic fruit. In the end of October of 1890, whilst on a visit to the Liverpool Marine Biological Station on Puffin Island, N. Wales, I collected a considerable quantity of the weed. It grows in that locality in abundance on the protected faces of rocks near high-water mark. On examining my latest gathering on my return to Liverpool, I was rewarded for my previous fruitless search by finding that many, if not all the plants bore not only tetraspores but antheridia and cystocarps as well. I sectionized a large number, and the results of my investigation I have now the honour of laying before the Society.

* Quekett Micr. Club Journ. ser. 2, iii. p. 257.

Vegetative Organs.

Catenella Opuntia grows most plentifully on the protected faces of rocks near high-water mark. It is anchored to the substratum by numerons root-branches which spring from the under surface of an irregularly-branched creeping rhizome, from whose upper surface arise the branched moniliform fronds, usually from 5 to 15 millim. high. The rhizomic portions are generally paler in colour than the erect axes, but, save that the regular moniliform structure is imperfectly or not at all developed, they do not differ from the erect fronds in character. The root-ramuli are simply modified branches splitting up at their apices into bundles of filaments, or in some cases single filaments (one cell broad). In these root-ramuli the small peripheral cells of the ordinary branch are much elongated, and lie more or less parallel to each other in the long axis of the ramulus. They are faintly or not at all coloured.

The creeping and erect parts of the frond do not differ in any essential from each other in histological structure. The central portion of the frond is composed of a loose network of elongated branched hyphæ, which on approaching the surface become shorter, ultimately branching again and again dichotomously and forming radially arranged chains of small rounded or ovoid cells. Those on the surface are united by their thick cell-walls into a peripheral layer, covered by a cuticle, whilst those beneath have small intercellular spaces and form an inner transitional layer to the retiform medulla. The cells of this intermediate layer are varied in form, but longer than the cells composing the peripheral layer (Pl. XIV. fig. 10). The apex of every ramulus is occupied by a tetrahedral apical cell. Protoplasmic continuity exists between all the younger cells of the frond; but later on this continuity seems to me to become interrupted by the growth of two plug-like thickenings which are at first rings, and finally discs. Prof. Schmitz, in the MS. notes which he has favoured me with, says "dieser Auffassung kann ich nicht beistimmen," and refers me to his published work on the subject *. I find that he expresses it as his opinion that whenever a cell divides, a peculiar opening is formed in the septum, by means of which the two new cells remain in communication with each other so long as they are in a living condition. This opening is, according to Schmitz, closed

* "Unters. ü. d. Befruct. d. Florid.," SB. Ak d. Wiss. Berlin, 1883.

by an exceeding thin membrane through which pass very fine strands of protoplasm. My friend Mr. Hick, of Owens College, in his investigations on "Protoplasmic Continuity in the Florideæ"*, maintains that there exists "unbroken continuity of the protoplasmic substances of the plant from the base of the frond to the tips of the ultimate branchlets."

With a Zeiss $\frac{1}{12}$ oil-immersion lens I have been unable to convince myself of the existence of the fine protoplasmic fibrillæ mentioned by Schmitz. I have seen what looked like extremely fine threads passing between the "plugs" and the end of the primordial utricle on either side; but these seem to me to be merely markings on the walls of the canals leading to the plugs. I have examined the same phenomenon in the genus *Polysiphonia* †, where I have shown that such heterogeneous markings do occur and give a deceptive appearance of interprotoplasmic communication. In some genera undoubtedly protoplasmic continuity is maintained between all the cells of the frond during life; but I cannot convince myself that that continuity, existing as it certainly does in younger cells, is maintained in all old cells, at least in the forms I have examined.

Reproductive Organs.

(*a*) *Asexual.*—The mother-cells of tetraspores are developed from the cells of the inner rind of special ramuli. Each mother-cell divides transversely by parallel walls, curved convexly outwards, into four daughter-cells; and the mode of formation of the tetraspores is therefore zonate. I have figured a young stage and three adult sporangia. I have nothing further to add to Kützing's description ‡.

(*b*) *Sexual Organs.*—The antheridia and procarps are borne on the same plant. Generally both male and female organs occur close together on the same erect frond. A not infrequent condition is that represented at fig. 11, Pl. XIV. I have occasionally found the penultimate internode of an erect frond cystocarpic and the ultimate internode antheridial.

Antheridia.—The only account and figures of the antheridia known to me are those of Buffham in his paper already quoted. The antheridial ramulus is, as Buffham says, easily distin-

* Brit. Assoc. Report, 1883, p. 547.

† "Notes on *Polysiphonia fastigiata*," Journ. Bot. xxix. no. 341.

‡ Tab. Phyc. vol. xvi. tab. 71.

guished by its wrinkled appearance. The surface is raised into a number of small mounds, each corresponding to what might perhaps be termed a nest of pollinoids. The ripe ramulus contains 30 to 50 such nests. The wall of each nest is composed of ordinary peripheral cells; but those forming the base of the nest are smaller and more rod-shaped. From these in turn arise the rather ovate pollinoids or spermatia which are shed into a cavity beneath the cuticle, escaping by a rupture in the membrane (Pl. XIII. figs. 5, 6).

Cystocarps.—The cystocarps are borne on the erect branches, every articulation (in my plants) bearing one or two cystocarpic ramuli. I have occasionally come across specimens with two cystocarps placed beadways on the same frond; but this is rare. Sometimes the cystocarp is the terminal articulation itself*. Each ramulus is nearly spherical and is shortly stalked, and easily distinguished, even when young, by the clear border which surrounds it, and by a fringe of delicate colourless short processes apparently arising from the interior, piercing the border and projecting at right angles to the surface. A transverse section of a mature cystocarpic ramulus under a low power ($\times 100$) shows, from without inwards, 1st, the clear hem already mentioned and colourless processes (though not nearly so numerous nor so distinct in the mature as in the young condition); 2nd, a tolerably broad zone of peripheral cells deeply coloured and arranged in radiating rows quite similar to the ordinary peripheral zone in the vegetative frond; 3rd, a zone of interwoven filaments, broader or narrower according to the stage of development; 4th, a broad zone of carpospores—large, deeply coloured cells, amongst which may be seen branched filaments uniting the zone of filaments with (5th) a small medulla of shorter interwoven cells. In the very young stage the carpospores are entirely absent, and the third zone and medulla are continuous, the cystocarpic nature of the ramulus being indicated at that stage merely by the clear border and its processes. If a longitudinal section be made of a young cystocarpic ramulus, the exterior will be

* During a recent visit (June 1891) to the locality where I first obtained *C. Opuntia* with cystocarpic fruit, I was fortunate enough to secure fresh material again bearing cystocarps. In many of the specimens which I gathered the erect fronds bore three, four, or even five cystocarpic ramuli; while on one specimen a single articulation gave origin to no less than nine such ramuli disposed all round the frond.

found to be bounded by a delicate cuticle pierced at intervals for the exit of the processes already mentioned. Immediately within is the clear border formed by the swollen coalesced outer cell-walls of the peripheral cells. Then follows the rind of cortical coloured cells, rather smaller and more numerous than, but similar in arrangement to, those of the ordinary branch. This layer passes gradually into the central weft of hyphæ continuous with those of the branch from which the cystocarp springs. In the inner portion of the rind and outer part of the medullary weft there arise from the cell-threads very numerous branchlets consisting of generally two cells, one short and rounded, the other, the trichogyne, broad at the base but tapering into a fine filament which pierces the rind and cuticle, and appears on the surface as a delicate colourless, or almost colourless, hair. Not infrequently this trichophoric apparatus consists of three cells—two basal trichophoric cells and the trichogyne (Pl. XIII. figs. 7, 8). Fig. 9, Pl. XIV., shows a small portion of the surface of a young cystocarpic ramulus highly magnified. To two of the trichogynia pollinoids are attached, while two others have not yet pierced the cuticle. The majority of the trichogynia in an older cystocarp may be seen to have pollinoids attached to them. The medulla of a young cystocarp consists of a weft or reticulum of almost colourless cells, the central row standing out rather prominently. Round the central row and connected with it are half a dozen or more rows of cells, branches from which form the beginning of the reticulum of smaller cells which gradually merges into the inner rind. Fig. 10 shows such a section (rather more than half the section is represented) taken in the exact longitudinal axis of the cystocarp, in which the features just described are seen. (The figure has been somewhat simplified by omission of all cells which do not come exactly into the plane of the section.)

After, and sometimes (so far as I can make out) before, fertilization of the trichogynia has taken place there appear a few small subsidiary cells round the trichophoric cell or cells. These subsidiary cells I imagined at first were young carpospores, and what I have termed trichophoric cells, carpogonia; and I interpreted the mass of spores found in an adult ramulus as composed of bundles of such derived from many carpogonia developed nearer to the central medulla. Prof. Schmitz, however, pointed out to me that I had misinterpreted these phenomena; and I am convinced now, after examining sections of very

young cystocarpic ramuli whose trichogynia had not been fertilized, that his interpretation of these as sterile vegetative cells is correct. He adds (in a letter to me), "Solche vegetative Zellen werden bei vielen Florideen während der Cystokarpentwicklung im Frucht-Spross neugebildet (z. B. bei *Gelidium*, *Gloiopeltis*, u. s. w.) oft durch Zellvermehrung aus den unbefruchteten Carpogonästen." Fig. 8 represents such a complex of sterile vegetative cells surrounding a trichophoric apparatus.

Fertilization is effected by the fusion of the pollinoids released from the antheridia with the trichogynia. The majority of the trichogynia are so fertilized. Each trichogyne is, as has been already shown, in direct communication by means of the trichophoric cell (or cells) with the subcortical weft of hyphæ, which is in turn continuous with the longer and larger medullary cells. When fertilization is complete, the development of carpospores commences. The uppermost of the central row of cells of the ramulus enlarges very considerably, and from it, as well as from the network of hyphæ surrounding it (and with which it is connected at many points), there are given off rows of rounded or ovoid cells (carpospores) much larger and more granular than those which (mixed with them) give origin to the rind-cells. By continued growth of these branched chains the subcortical reticulum is separated and the meshes become filled with carpospores, between which the sterile filaments pass to the periphery. The larger cell of the central axis in a transverse section of an old cystocarp shows itself to be yellowish, granular, branched, and connected on all sides with the network of filaments from which the carpospores arise (Pl. XIV. fig. 12).

There is no carpostome, and doubtless the spores escape by rupture of the rind and cuticle, the latter already weakened by the numerous apertures occurring in it through which the trichogynia pass to the exterior.

It will be seen, then, that the mode of formation of the cystocarp in *C. Opuntia* differs in many points from the more usual Floridean type. In the first place, although the trichophoric systems are very numerous, only one cystocarp is produced. Further, fertilization is indirect; for instead of the carpospores being produced from the cells immediately beneath the trichogyne, they are developed in chains from the medullary network of cells continuous with that from which the trichophoric cells and trichogynia arise. There can be no doubt, however, that the processes

so numerous on the exterior of the cystocarp ramulus are physiologically and morphologically trichogynia, and that the carpospores arise as the result of the transmission of a fertilizing stimulus to the medullary weft from them. My reasons for believing this to be so are:—(1) The obvious similarity of these trichophoric systems to those of other Florideæ; (2) the fact that bodies identical with the pollinoids formed in the antheridia can be seen attached to the trichogynic processes; (3) that the carpospores are formed only subsequently to the fusion of the pollinoids with the trichogynia, and that the trichogynia wither after the carpospores begin to develop; (4) that I have seen no evidence whatsoever of any other organ by which fertilization might be effected; (5) and lastly, that there exists direct communication between the trichophoric cells and the cells from which the carpospores arise.

EXPLANATION OF THE PLATES.

Plate XIII.

Fig. 1. *Catenella Opuntia,* with terminal and lateral cystocarps. Nat. size.

Figs. 2, 3, 4. Stages in the development of a tetrasporangium. $\times 350$.

Fig. 5. Vertical section of a young antheridium. $\times 350$. One "nest" only is shown.

Fig. 6. Fully developed "nest" of pollinoids in vertical section. $\times 350$.

Figs. 7, 8. Trichogynia and trichophoric cells arising from the subcortical cell-network. $\times 350$.

Fig. 7 shows a trichogyne which has not yet pierced the cuticle, and which is provided with only one trichophoric cell. Fig. 8 shows two trichophoric cells surrounded by a number of vegetative cells.

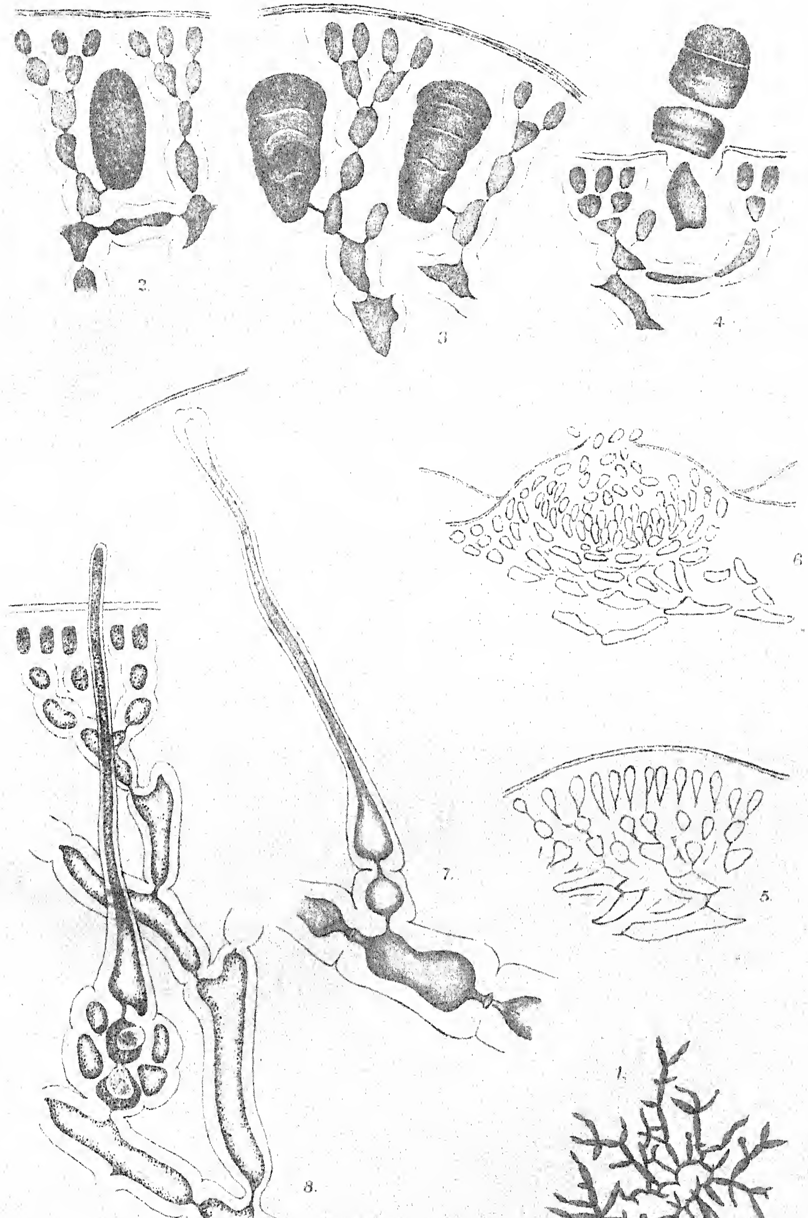
Plate XIV.

Fig. 9. Peripheral layer of a young cystocarp, with pollinoids attached to two trichogynia. $\times 500$.

Fig. 10. Vertical longitudinal section of a young cystocarpic ramulus. $\times 350$.

Fig. 11. Frond with antheridium (*b*) and nearly mature cystocarp (*a*). $\times 20$.

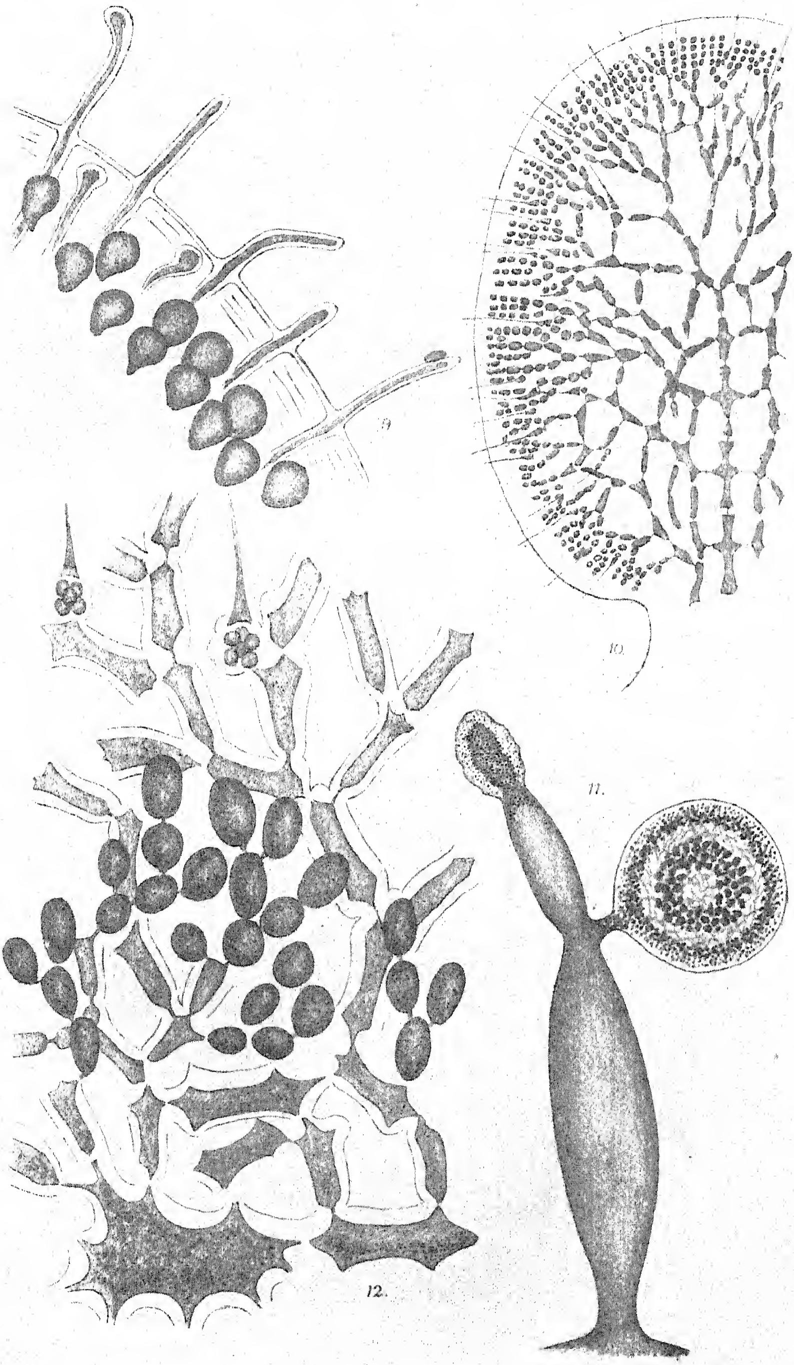
Fig. 12. Development of carpospores from the medullary network. A few carposporic chains only are represented. $\times 350$.



R. J. H. G. del.
Berjeau & Highley lith.

West, Newman, imp.

CATANELLA OPUNTIA. *Grev.*



R.J.H.G. del.
Berjeau & Highley lith.

West, Newman, imp.

CATANELLA OPUNTIA *Grev.*

On the Cystocarps of some Species of *Callophyllis* and *Rhodymenia*.

By John Bennett Carruthers, F.L.S.

[Read 5th June, 1890.]

(Plate XV.)

In his 'Epicrisis Floridearum' (1876, p. 328) J. Agardh has divided the genus *Rhodymenia*, Grev., into three sections—Palmatæ, Palmettæ, and Clinophora. The section Palmatæ includes three species, viz. *Rhodymenia pertusa*, Post & Rupr., J. Agardh, *R. peruviana*, J. Agardh, and *R. palmata*, Grev. In no species of this section has Agardh found cystocarps (Epic. Flor. p. 318); and no other writers have found cystocarps of these species. Ruprecht alone* has described cystocarps of *R. palmata*; but these do not appear to be genuine cystocarps. Harvey has observed the existence of the cystocarps of *R. pertusa*† (from a specimen collected on the north-west coast of America).

This being so, I had the good fortune to be shown in the Cryptogamic Herbarium of the Natural History Museum at South Kensington specimens of *R. palmata*, *R. pertusa*, and *R. peruviana* which bore distinct cystocarps, the study of which was naturally of great interest.

Encouraged by Mr. Murray, of the Cryptogamic Herbarium of the British Museum, I began the examination of the fruits of the specimen of *R. palmata* in the Botanical Department of the Natural History Museum; and afterwards continued the study of all these specimens under the guidance of Prof. F. Schmitz in the Botanical Institute of the University of Greifswald; and the following is the result of my work.

I.

There are two specimens of *Rhodymenia palmata*, Grev., in the Cryptogamic Herbarium of the British Museum, both with cystocarps and both from the collection of Dickie. They bear the inscription:—"*Rhodymenia palmata*, var., Santa Cruz, Bay of Monterey, 1873, Dr. C. L. Anderson." My attention was specially directed towards one of these two plants.

The thallus of this specimen is flat and repeatedly forked, growing more or less irregularly in a fan-like shape. The segments are

* 'Algæ Ochotenenses,' pp. 74–75.

† Journ. Linn. Soc., Bot. vi. (1862) p. 171.

small, linear to broad, and generally dichotomous. The young thallus in the dry state is of a reddish-brown colour, and adheres pretty firmly to the paper. The cystocarps are produced in varying numbers over the whole of the upper parts of the thallus and scattered quite irregularly over the segments.

This form of thallus is not in accordance with the typical form of *Rhodymenia palmata*; and this fact goes to support the opinion that this specimen is not to be considered as *Rhodymenia palmata*; but since there are so many varieties of this very common alga, it is possible that it is a specimen of a new variety, and no doubt the determination was made with that notion. Of greater importance is the study of the anatomical structure of the thallus.

The first thing which strikes the attention in a transverse section through the thallus is the existence of two distinct parts—a thick centre or medullary cell-layer, and on both sides a comparatively thin cortical layer. The centre part consists of a layer of two or three large round or oval cells, which are arranged in no regular order, but lie parallel to the surface of the thallus. The spaces between the large cells (which, owing to their round form, are not adjacent at all parts) are filled everywhere by small round or long cells of varying sizes according to the interstices, but joined in continuous branches.

On both sides of the centre part is a layer of smaller cells, generally one fifth as thick as the medullary layer, the cells of which are much smaller than the interstitial cells of the centre part, so that a clear line of demarcation can be drawn between the two portions of the thallus. This outer portion, in its turn, can be divided into an outer and an inner portion—the outer portion consisting of a layer of very small cells, the inner portion formed of a layer of larger cells. The outermost row of cells are very close together, forming a compact cortical layer.

These points of the anatomical structure of this alga show that it cannot be considered as *Rhodymenia palmata*, Grev. That alga (a specimen of which from the Bay of Bathus—Rabenhorst, Alg. Eur. No. 1745—I have examined) has only a single layer of large cells in the centre or medullary part, and no interstitial cells between them. That the position of this specimen is not in the genus *Rhodymenia* is thus to be seen, but to determine exactly its generic position it is necessary to study the fructification.

The cystocarps are small flat lenticular swellings, and on the

dried specimens are from 1 millim. to 1·5 millim. wide. They appear in equal numbers on both sides of the thallus quite similarly and slightly darker in colour than the other portions of the frond. They are scattered over the whole of the upper part of the thallus.

A transverse section through the mature fruit shows that the cystocarp is oval, equally projecting on both sides of the segment, and possessing a fairly thick wall. This wall consists of a varying number of cells, the outermost being the smallest and the two outer layers being arranged at right angles to the surface of the thallus. In this wall, but on one side only, is the opening for the expulsion of the spores, usually a single ostiole, but occasionally two. The part of the wall where the ostiole is formed is thicker, and from the cells at the side of a pore project thread-like cells at right angles to the ostiole. The ostiole is widest at the point nearest the inner part of the fruit-nucleus, and is contracted at the cortical part of the fruit-wall. The nucleus itself consists of a varying number of spore-clusters arranged quite irregularly, and separated by thin walls of interwoven filaments very close in texture.

This structure of cystocarp confirms the opinion with respect to this specimen, that it does not belong to the genus *Rhodymenia*, and shows that it is a species of *Callophyllis*. Compared with the different species hitherto described it completely agrees with *Callophyllis obtusifolia*, J. Agardh (figured in Agardh, 'Morphologia Floridearum,' pl. xiv. figs. 1 & 2).

II.

I have closely studied only one of the two specimens named as *Rhodymenia palmata*, Grev. (from Dickie's herbarium), collected by Dr. Anderson at Santa Cruz (Bay of Monterey), and now in the Natural History Museum; the other I have not been able to examine so thoroughly. This last bears some resemblance to the first specimen; but is also, even from its outer form of thallus, not a typical specimen of *Rhodymenia palmata*, Grev. The anatomical structure of the thallus agrees, in general, with *Callophyllis obtusifolia*, J. Agardh, but differs from the first of Dickie's specimens in details of structure. The centre layer consists of large cells three or four deep, and not, as in the previous specimen, two or three; the interstitial cells are somewhat smaller than in the other plant: the points of contact of the large

cells of the medullary layer are larger in this specimen; but a more essential difference exists in the fact that the cystocarps are not in the middle of the thallus, but the swelling projects considerably on one side and very slightly on the other. In a transverse section the nucleus can be clearly seen occupying a position nearer the swollen than the comparatively flat side of the cystocarp.

The composition of the fruit and the anatomical structure of the thallus do not point to the position of this alga in the genus *Rhodymenia*, Grev., but rather in the Section V. of *Callophyllis*, J. Agardh ('Epicrisis Floridearum'); but I had not a sufficient amount of material to thoroughly compare this specimen with the described species of that Section.

The study of the above-mentioned specimens of *Rhodymenia pertusa*, J. Agardh, and *R. peruviana*, J. Agardh, from the herbarium of the British Museum, leads to a similar result. Both specimens are from the collection of Dickie, and are dated from the North-west coast of America; but both plants prove, on examination, to be incorrectly determined. In both cases they appear to belong to the genus *Callophyllis*; but I was not able, owing to lack of material for comparison, to determine accurately their specific position.

The attempt to learn the structure of the cystocarps of *Rhodymenia palmata*, Grev., from the two specimens in the Natural History Herbarium has not been successful; and as these cystocarps have not yet been discovered—though the other methods of propagation of this species, viz. antheridia and tetraspores, have frequently been found—it is not possible to conjecture as to the character of these fruits of this species; and it is possible that the discovery of the structure of the cystocarp may lead to the classifying of *Rhodymenia palmata* in a different position.

I have also not been able to examine the cystocarps of *R. peruviana*; but I have studied the fructification of the third species of this section, viz. *R. pertusa*, J. Agardh. I had the fortune to see one of the specimens which Harvey has mentioned. The plant, now in the herbarium of Trinity College, Dublin, was collected by Lyall in 1858 on the north-west coast of America (Point Roberts). On this specimen the cystocarps occur all over the surface of the segments, which are much perforated; the majority are very young, and project very little from the surface of the thallus.

Through the kindness of Prof. Schmitz, who has allowed me to study some of his preparations of this species, I have seen that the anatomical structure of the thallus is similar to that of *R. palmata*, the typical *Rhodymenia* species*, viz. a thicker centre or medullary layer of larger cells which are not surrounded by small interstitial cells, but lie closely together (in the species *R. pertusa* perhaps even more so than in the type *R. palmata*). The cortical cells are arranged in more or less irregular order, with the exception of the outer layer, which is distinctly at right angles to the cortex; the cells of the cortical layer are larger towards the inner part of the thallus, and decrease in size towards the cortical layer; so that the outermost layer consists of the smallest cells which lie close together, forming a more or less compact cortex.

The cystocarp shows a similar resemblance to that of the typical species of the genus, *Rhodymenia palmata*. It projects on one side of the thallus, and possesses a fairly thick fruit-wall of five or six cells in thickness arranged irregularly inwards. At the bottom of the fruit-cavity is to be found the placenta formed of numerous small cells closely packed together, and lying on the medullary layer of large cells. From this placenta the gonimoblast, of a more or less circular shape, is borne on an elongated style-cell, and spreads upwards into the empty fruit-cavity.

This gonimoblast is composed of numerous pear-shaped lobes which lie close together. The spores of these lobes become ripe nearly at the same time.

The ostiole is generally quite in the centre of the projecting fruit-wall, and is similar to the ostioles of the kindred species.

This structure shows that this is a true species of the genus *Rhodymenia*. The other two species of the same group must remain doubtful as to their true generic position until the cystocarps have been found and described.

III.

In studying the structure of the above-mentioned specimens of *Callophyllis*, I was induced to observe also the development of the fruit; and though I cannot give a complete history of

* Schmitz, "Systematische Uebersicht der Gattungen der Florideen," Flora, Jahrg. 72 (1889), p. 435.

the processes of sexual fructification, yet I have noticed much that may be interesting.

I have observed specially one of the specimens of *Callophyllis obtusifolia*, J. Agardh. In this specimen the procarps were either too degenerated—not having been fertilized—or in much too late a stage of development to thoroughly observe the different stages of growth. They appear scattered without any order over the whole of the upper segments. They take place within the thallus between the cortical layer and the medullary part. The procarps which I have observed consist of a group of cells in shape like stags' horns, but broader and flatter; these cells project from a common point of attachment inwards towards the medullary layer and between the large cells. I could not find younger states of these procarps; and so could not ascertain the normal form of the carpogonial branch. I was also not able to see out of which cell of the carpogonial branch the spore-bearing branches originate. The first process immediately after the fertilization of the procarp is the formation of very numerous small cells and short rhizoids in the tissue around the procarp; these cells are formed chiefly in the medullary part of the thallus between the large centre cells, and cause a slight swelling of the whole medulla at that point. At the same time there is also an increase in the cells of the cortex, which is extended outwards; and so arises at the point of the fertilized procarp a lens-shaped swelling of the thallus equal on both sides.

This slight swelling of the thallus represents a fruit in a very young state of development. The fruit-wall consists of a varying number of cells, but is very much thicker than the cortex before fertilization. The cells of the outermost layer are arranged at right angles to the surface of the wall; but those nearer the centre of the swelling have no apparent order, and are larger than the outer cells, the innermost cells being the largest, and being surrounded by smaller interstitial cells in fairly large numbers. The whole fruit-wall is usually pretty compact, though not so much so as in the cortex of the ordinary thallus. The young fruit-nucleus—the thickened part of the medulla—now shows the large cells parted asunder, and surrounded by more or less compact masses of interstitial cells. This young fruit-nucleus includes, on one side in the part nearest the cortex, the remains of the fertilized procarp. From this procarp had begun, it would appear, the increase of the interstitial cells of the nucleus; also

probably from this procarp originate the fertile cell-rows of the gonimoblast. I could not discover exactly at what stage of the development these cell-rows begin, but they appear already in an early state of the fruit, when the swelling is comparatively small. These fertile cell-rows grow as thin filaments through the interstitial tissue between the large cells of the young fruit-nucleus, and form, with these interstitial cells and rhizoids, a compact filamentous interweaving. In this tissue the fertile cell-rows are nourished at the expense of these interstitial cells, which are often not easily distinguishable from the cells of the fertile cell-rows.

During the formation of this filamentous tissue the whole nucleus increases gradually, and assumes a more or less thick lens-shaped form. This nucleus shows innumerable interwoven slender filaments, and, scattered through them, the whole medullary cells sometimes a little compressed.

In this increasing filamentous tissue at different points small cavities appear by unequal extension. These spaces are quite irregular in size, and are bounded on all sides by a compact wall of filamentous tissue. From the side of the spaces spring numerous short lateral branches of these filaments, which either remain undivided or are branched dichotomously. At the apex of these branches the cells form clusters of small cells of various shapes.

These clusters * are composed of from four to seven cells each, sometimes more, which lie close together arranged in different ways. In a later stage of the fruit they become fully developed spores.

The number of these fertile branches in a single space is variable, and therefore the size of the spaces differs also.

The spore-forming clusters of each space are almost always in the same state of development. The cells of these clusters gradually develop into spores, and then all the clusters are conglomerated into a single glomerule. All the glomerules of a fruit-nucleus are also always in the same state of development;

* Naegeli ('Neuere Algensysteme,' p. 239) has already described the development of these clusters in *Callophyllis laciniata.* From his description, the single cluster always grows with a two-edged apex-cell from which are cut off, alternately to right and left, segment-cells. The clusters of the above-mentioned specimn of *Callophyllis obtusifolia* are certainly not propagated in such a regular manner, and the apex-cell is also not two-edged.

and in the ripe fruit as well the spores are nearly always of the same maturity.

These fertile cavities are distributed in fairly large numbers over the whole space of the fruit-nucleus; the individual spaces are separated by more or less thick layers of the interwoven filaments. Dispersed between these spaces many of the old medullary cells can be seen, generally compressed, but still relatively very large; and it is specially clear that these old medullary cells have no connexion with the formation of the nucleus.

In each fruit-nucleus many of the fertile cavities are quite on the border of the filamentous network, and touching the innermost cells of the cortex. These cells, as before mentioned, are surrounded by small interstitial cells and filamentous rhizoids, and so form what may be termed an involucral layer; but this layer is so little characteristic here in *Callophyllis obtusifolia*, that it is better not to speak of it as a separate layer *.

About the same time as the spore-clusters are beginning to develop, a further thickening of the cortex on both sides of the fruit commences. At one side of the fruit, at the place where the procarp originally was, the cells of the wall part assunder, and there arises a cylindrical canal through the whole thickness of the wall. The cells at the sides of this fruit-pore † develop dense masses of hair-like cells at right angles to the pore, and nearly filling the whole of the canal. The pore is often formed very early, before the formation of the spore-glomerules and before the spore-clusters have developed in size and have become fully matured spores. Such cell-clusters gradually develop into spores, the single cells become larger and more intensely coloured;

* If such an involucral layer in other species of *Callophyllis* is distinct enough to be considered as a peculiar layer I cannot say. J. Agardh expressly mentions, in his 'Epicrisis Floridearum,' p. 228, in the description of the genus *Callophyllis* such a layer ("nucleum . . . . plexus peculiari ambitu definitum"); and also in his 'Morphologia Floridearum,' pp. 205 and 206, for *Callophyllis* a "stratum circum nucleare" round the fruit-nucleus is noticed. He attributes to this layer an important part in the development of the fruit. So far as the species of *Callophyllis* which I have studied is concerned, this layer is so indistinctly defined, that it is not easy to clearly distinguish it; and it is certainly quite without peculiar function in the development of the cystocarp.

† In some cases I have found that in the middle of one fruit-wall two pores were built. As the fruit was too old, I cannot decidedly say whether there were two fertilized procarps near together, which developed one cystocarp. I have never observed two pores at different sides of the cystocarp.

and when they are mature, the connexions between the individual spores are gradually loosened, the whole glomerule becomes disintegrated, and, finally, the fully developed round spores are entirely free.

Owing to their appearance, these glomerules of spores, which are, as has been mentioned, in varying numbers without order in the nucleus, may seem to be separate fruit-nuclei * which make a compound fruit. But the description before given of the development of the cystocarp in the observed species clearly shows that the glomerules originate in a way inconsistent with this theory.

As the spores ripen, they expand throughout the cystocarp, and then follows the escape through the pore and the scattering of the spores. But the expulsion is very slow and incomplete. In many of the older fruits I have observed a smaller or larger number of ripe spores which remained in the cystocarp and had begun to germinate. Sometimes the majority of the spores had not been expelled. In none of the material that I have studied have I found anything to uphold the supposition that a part of the fruit-wall is broken down so as to allow the escape of the spores, or that the whole cystocarp is, when the spores are fully ripe, loosened from the thallus †.

In the above notes on the development of *Callophyllis obtusifolia* very little mention is made of the literature existing on this subject; but very little is to be found regarding the fertilization of the genus. J. Agardh only has given, in his 'Morphologia Floridearum,' a short account of the development of this cystocarp, in speaking of the fruit of Gigartineæ (pp. 202–208) (*cf.* 'Epicrisis Floridearum,' p. 174). The fruit-nucleus of *Callophyllis* is described as being composed of many small fruit-nucleoli, which are formed within the large medullary cells of the thallus.

* For example, J. Agardh says, in his description of *Callophyllis* ('Epicrisis Floridearum,' p. 228), "Cystocarpia disco aut margine frondis immersa, nucleum compositum, plexu peculiari ambitu definitum, disruptione partis demum liberatum, foventia; nucleoli intra cellulas rotundatas strati medii singuli recepti filisque placentaribus reticulatim ambientibus invicem disjuncti, rotundati, gemmidia pauciora rotundato-angulata, sine ordine conspicuo conglobata, continentes."

† For example, J. Agardh says ('Morphologia Floridearum,' p. 203) in *Iridæa* the ripe fruit is finally loosened from the thallus.

These notes do not confirm J. Agardh's observations, but rather show that the development of the fruit of *Callophyllis obtusifolia* agrees in main points with the mode of development which Bornet ('Notes Algologiques,' i. pp. xviii–xix) has described of the cystocarps of *Gymnogongrus* and *Callymenia*, and Schmitz ('Untersuchungen über die Befruchtung der Florideen,' p. 30) of *Gigartina* and *Chondrus*.

EXPLANATION OF PLATE XV.

Fig. 1. Section through mature cystocarp of *Callophyllis obtusifolia*.
Fig. 2. Section through ostiole.
Fig. 3, *a, b, c, d*. Spore-clusters.
ig. 4. Spores germinating within cystocarp.

On a new Fossil Plant from the Lower Coal-Measures. By Thomas Hick, B.A., B.Sc., Assistant Lecturer in Botany, Owens College, Manchester. (Communicated by Wm. Carruthers, Esq., F.R.S., F.L.S.)

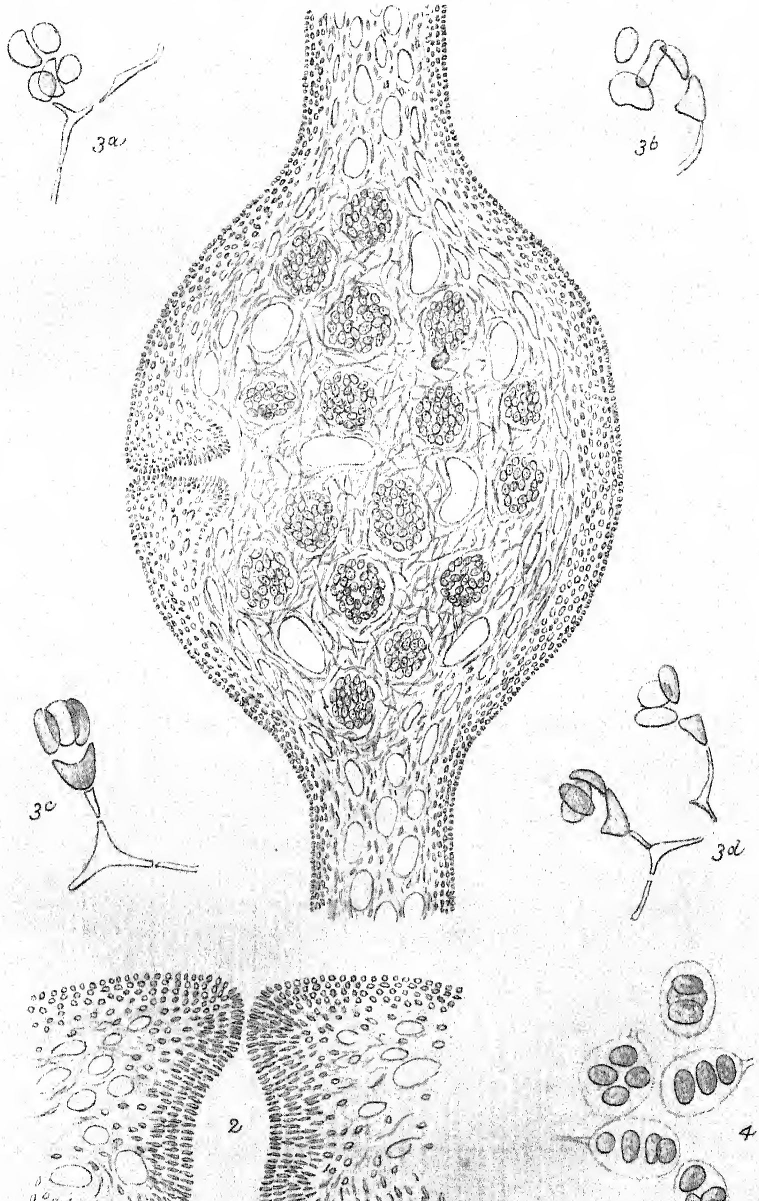
[Read 19th November, 1891.]

(Plates XVI. & XVII.)

The specimen described in the following pages was found by W. Cash, Esq., at Cinder Hills, Siddal, near Halifax, who, though himself a student of Coal-Measure botany, has generously placed its description in my hands.

The external appearance bears some resemblance to that of *Stigmaria*, as its surface carries a series of markings which have a quincuncial arrangement (Pl. XVI. fig. 1, *a*); but whilst the markings of *Stigmaria* are usually depressed scars, those of the specimen are slightly elevated and differ in other respects. When found, it was about 1·1 decimetre in length, with a diameter of about 5 centimetres, and though generally cylindrical in shape, was slightly compressed on two opposite sides.

The description of its anatomy and histology is based upon half a dozen transverse sections and a number of short longitudinal ones, partly radial and partly tangential, prepared by Mr. James Lomax, of Radcliffe. It is not pretended that any



Berjean & Highley del. et lith.

Hanhart imp.

CYSTOCARP OF CALLOPHYLLIS OBTUSIFOLIA.

single section shows all the details mentioned; but nothing is recorded which is not visible in one or more of them and is at least consistent with the less definite structure of the rest. A prolonged study of the sections has led to the conviction that the specimen is a fragment of some Carboniferous plant which differs in important points from anything that has been previously described. It may represent a developmental stage of one of the forms already known; but there is no evidence of this at present, and hence it must stand apart, at least provisionally.

General Structure.

The general structure of the specimen, as indicated by the transverse and longitudinal sections, is as follows:—

1. The centre is occupied by a cellular pith whose diameter is about 2½ centimetres. From all the characters it presents, this appears to be a true pith, and not merely the central part of an axile vascular strand which has remained parenchymatous. (Pl. XVI. fig. 2; Pl. XVII. figs. 3, 4, *p*.)

2. Surrounding the pith is a ring of primary vascular bundles of the collateral type. They vary in breadth tangentially, the broader ones suggesting by their appearance that they have been formed by the lateral coalescence of narrower ones (Pl. XVII. figs. 3, *vb*). At certain points of the bundle-ring small bundles have left it * on the external side, and are evidently passing off to lateral appendages of some kind (Pl. XVII. fig. 4, *ab*). Like the bundles of the ring, these are collateral. The extreme diameter of the bundle-ring is about 5 centimetres.

3. Between the vascular bundles run the medullary rays (figs. 3, 4, *mr*), which are relatively broad bands of parenchyma. The isolated bundles just mentioned as leaving the ring stand opposite to medullary rays (fig. 4).

4. The ring of vascular bundles is enclosed by an extremely thick mass of tissues, which may be provisionally spoken of as the enveloping tissues (Pl. XVI. fig. 2). Their structure is not uniform, and presents characters which, compared with those found in the same position in other coal-plants, are remarkable. The whole mass is so thick that it brings up the total diameter of the spe-

* Or are entering it. It is obviously immaterial which mode of expression is used.

cimen to $4\frac{1}{2}$ decimetres. There are no leaf-cushions at the outer periphery; but in two of the sections what appear to be two rootlets project from one side of it (Pl. XVI. fig. 2, *r*).

Histology.

Pith (Pl. XVII. figs. 3, 4, *p*).—The pith is cellular throughout. In the transverse section the cells are rounded or polygonal in shape, and vary in diameter from 0·061 to 0·02 millim., or even less, the larger and smaller being irregularly intermingled. Intercellular spaces lie between them. The walls are not much thickened, but are often irregularly folded, as if by external pressure. Some of the cells are filled with a black substance such as often occurs in the tissues of Carboniferous plants, which is probably of organic origin, though this is not certain. Save this, there are no indications of any organic contents, the finely granular appearance seen in some of the cells being most likely due to infiltered mineral matter. The cells do not markedly diminish in size towards the periphery, as do those of some Dicotyledons, but the walls are thinner.

In the longitudinal sections the cells are seen to be much elongated longitudinally, the length reaching from 3 to 5 times the transverse diameter. For the most part they run in linear series, but this arrangement is here and there lost or obscured. The end-walls are partly rectangular and partly oblique.

Vascular Bundles.—It has been mentioned that the vascular bundles vary in breadth tangentially, owing apparently to lateral coalescence. The transverse sections suggest that some of the bundles are made up of two and others of three smaller bundles which have united in this way (Pl. XVII. fig. 3, *vb*). Further, the bundles vary somewhat in breadth and proximity as we pass from one section to another, indicating that in the short space between the sections they ran somewhat tangentially oblique.

Xylem.—As in most other Carboniferous plants, the xylem part of the bundles is well preserved and is sharply differentiated (figs. 3, 4, *x*). It consists of tracheæ * of the scalariform type, arranged in radial rows, in which the smaller are usually near the pith, and the larger at the outer periphery. In some

* In De Bary's sense. See 'Comparative Anatomy,' Engl. ed. p. 155.

instances, however, the diameter of the tracheæ is nearly uniform. The average diameter is about 0·04 millim., but some reach 0·061 millim., while others are not more than 0·014 millim. Where a radial row contains tracheæ of different sizes, the change is either abrupt or gradual, and when a certain maximum has been attained there is no further increase. The number of tracheæ in each row is seldom above 6 or 7, and may be as low as 3 or 4, and in several instances the outermost have their walls still unthickened, showing that the order of development has been centrifugal. In some of the bundles the rows of tracheæ are in close contact laterally, and no xylem parenchyma appears to be intercalated between them. In others the transverse sections show the rows of tracheæ separated by what looks like thin-walled parenchyma, but this is not found in the longitudinal sections. In the radial direction the tracheæ appear to be united directly in all cases. In no part of the xylem has any trace been found of sclerenchymatous fibres.

Procambium or Cambium.—Outside the xylem of each bundle is a thin layer of cells (Pl. XVII. fig. 3, *c*), small in size and with delicate walls, which form a tissue that is either of the nature of fascicular cambium, or is part of the procambium string which has not been converted into xylem and phloem. Against the former alternative is the fact that the elements do not show a radial arrangement, although in one or two of the bundles there is an approximation to this. Interfascicular cambium is also altogether absent. On the whole, the evidence is against the view that this is a cambium layer, and leans rather to the second alternative of procambium. This, however, does not preclude the possibility of its subsequent conversion into cambium.

Phloem.—A narrow zone of tissue, averaging 0·169 millim. in breadth, lies outside the layer just described (fig. 3, *ph*). In most of the sections it has undergone much disorganization, and no histological elements are recognizable in it. In two of them, however, it is better preserved, and these show that it is interrupted opposite the medullary rays, and really consists of as many separate masses as there are masses of xylem. This feature and the position the layer occupies seem to show that it represents the phloem part of the vascular bundles. Its elements, where preserved, are seen to be mostly thin-walled, but some of them have the appearance of young sclerenchymatous fibres, especially towards the outer periphery. As, however, they are

only seen in transverse section, it is impossible to say whether the fibrous structure is present or not.

Medullary Rays (Pl. XVII. figs. 3, 4, *mr*).—The medullary rays vary in breadth from 0·085 millim. to 0·212 millim., and are made up of rather large-celled parenchyma. In the broadest and best preserved the cells seem to be distinctly elongated radially, but neither in shape nor arrangement is there much regularity, and the walls show little or no thickening. As mentioned above, they run uninterruptedly through the tissue regarded as phloem.

Pericycle (?) (figs. 3, 4, *pc*).—Surrounding the whole of the vascular-bundle ring is a zone of parenchyma whose designation must be provisional owing to its somewhat uncertain homology. Its elements are small, averaging 0·034 millim. in diameter, but somewhat uniform in size, thin-walled, and in their general appearance not unlike the cells of meristem. In some instances the primordial utricle appears to be preserved, suggesting a condition of functional activity. The line of separation between this zone and the tissues outside is clearly marked in most of the sections, but there are no indications of an endodermis. Even where the line is less sharply marked there is a very obvious difference in the size, appearance, and arrangement of the cells on the two sides of it (fig. 4, *pc*).

Two views at least are possible as to the nature of this layer of tissue. It may be regarded either as a portion of the phloem, or as a many-layered pericycle* lying between the phloem and the outer tissues.

If it were a portion of the phloem, the medullary rays might be expected to run through it and merge in the tissue beyond. This, however, does not occur in the majority of instances, as most of the rays stop short at its inner margin. On the other hand, there are rays which are prolonged into this layer, but this only occurs where a vascular bundle is leaving the ring, as already described (fig. 4). Where this happens, the medullary ray follows the bundle, as it were, for a short distance, while the layer in question is still visible on the outside (fig. 4, *pc*). It would seem, then, that there is no real interruption of this layer, which is continuous at all points, and cuts short the medullary rays at its inner margin. On these grounds I am inclined to regard it, at any rate provisionally, as a many-layered pericycle.

* Van Tieghem, 'Traité de Botanique,' 2nd ed. pp. 674, 739.

The Enveloping Tissues (Pl. XVI. fig. 2).—Lying outside the entire series of structures hitherto described is an enormously thick mass of tissues, the various parts of which are certainly not equivalent to one another, either in histological character or in origin and development. Their massiveness is indicated by the fact already mentioned, that the total diameter of the specimen is nine times that of the vascular-bundle ring.

At a distance of a few millimetres from the extreme edge of the transverse section there runs an undulating line roughly parallel to it, which marks a difference of histological structure between the tissues on the inner and outer side of it (fig. 2, *l*). At two points on one side of the section shown in these figures the outer tissue dips down into the inner mass for some distance, and is traceable in one case as a narrow band nearly up to the pericycle (fig. 2, *i*). On the other hand, the inner tissues send out several short prominences into the outer zone, and this appears to have some relation to vascular bundles which lie at their distal ends (fig. 2, *c*).

On the ground of the facts observed in the various sections and of the histological structure of the whole, I am disposed to regard the outermost narrow zone (fig. 2, *d*) as the *true cortex*, and the more massive tissues lying between it and the pericycle as something intercalated by secondary developments. Imbedded in these latter we find numerous root-like structures, which are either organically connected by the parenchyma in which they lie, or are separated by extremely narrow fissures. Hence we shall find it convenient to speak of the whole of the enveloping tissues as being composed of *true cortex* and *radicular tissues.*

The True Cortex forms a narrow zone at the circumference of the transverse section (fig. 2, *d*). The outer periphery is so ill-defined that its identity with the epidermis is doubtful, and rather suggests that the superficial layers have disappeared. It is cellular throughout, and even to the naked eye has a different appearance from the radicular tissues.

Where the peripheral part is best preserved, the following layers are distinguishable as we pass from without inwards :—

i. A layer 5 or 6 cells deep, whose elements are arranged in tangential series, and are slightly elongated in the same direction, having an average size of 0·085 millim. by 0·0425 millim. (fig. 2, *a*).

ii. A layer apparently 3 cells deep, whose lumina are for the

most part filled wholly or partially with a black or brown material. The cells of this layer are larger than those of i., and, as far as can be made out, are less regularly arranged. The contents of the cells gives the layer, when seen with the naked eye or a hand-lens, the appearance of a dark line running near the margin of the section (Pl. XVI. fig. 2, *b*).

iii. The next layer is thicker than both the preceding ones, reaching nearly 2 millim., and consisting of from 12 to 20 rows of cells (Pl. XVII. fig. 5, *a*). These vary in size, becoming slightly smaller inwards, are rounded or polygonal in shape, and exhibit neither a definite arrangement nor any radial or tangential compression. The average size is about 0·127 millim. by 0·085 millim.

iv. A zone consisting of radially arranged rows of cells traceable all round the sections except where they are incomplete (Pl. XVI. figs. 2, *e*; Pl. XVII. fig. 5, *b*). The thickness of the zone shows some variation, and its limits are rather uncertain at some points; but in well-preserved parts the rows contain from 8 to 12 cells. From the position and character of this zone, I am inclined to regard it as a periderm, though there is no evidence that the cell-walls are suberised.

v. Beneath this periderm we have what is practically a continuation of the tissue described in iii., the two forming a single zone in which the supposed periderm has arisen (Pl. XVI. fig. 2, *d*; Pl. XVII. fig. 5, *c*). The thickness of this inner portion varies considerably in different parts of the section according as it is encroached upon to a greater or less extent by the radicular tissues. The cells increase in size from without inwards, but their arrangement is irregular throughout.

The Radicular Tissues.—It is difficult, if not impossible, to give any adequate idea of the characters and grouping of these tissues in words. As already stated, they include a number of root-like structures, each of which contains a single vascular bundle enclosed by a variable amount of parenchyma. Running irregularly through the mass and dividing it into irregularly shaped portions are numerous bands of tissue strongly resembling periderm, some of which are accompanied by narrow fissures, especially in the peripheral region (Pl. XVI. fig. 2). In several instances the portions of tissue enclosed by these fissures or peridermal bands contain one of the bundles mentioned, so that the whole presents the appearance of a number of roots whose peripheral tissues have become closely pressed together or even organically united.

The *innermost zone* of these radicular tissues abuts upon the tissue described as probably the pericycle, into which it passes without any break in the organic continuity (Pl. XVII. fig. 3, *iz*). Its constituent cells, however, are much larger and very different in appearance from those of the pericycle. They show, moreover, at some points a slight tendency towards a radial arrangement; but this is ill-defined, and is soon lost in passing outwards.

The Vascular Bundles are found at all distances from the vascular-bundle ring, and are not restricted to a limited number of radii (Pl. XVI. fig. 2, *ab*). Those near the ring are cut approximately at right angles, while the rest are more or less oblique. But even near the periphery the obliquity is frequently very small, indicating that some of them have a nearly longitudinal course. Others, however, appear to run more obliquely and at length pass out at the surface. As in other vascular bundles a xylem part and a phloem part can be distinguished, the former being turned towards the centre, and the latter towards the periphery (Pl. XVII. fig. 6, *ph*, *x*). This orientation is retained all through the enveloping tissues, but the transverse sections * offer no evidence as to whether or not it changed when the bundles entered the appendages. The xylem is triangular in shape and consists of thick-walled tracheæ, mostly of the scalariform type, while the elements of the phloem have thin walls and are nowhere sclerenchymatous. The bundles give no evidence of secondary growth, and retain their original dimensions, so long at any rate as they run in the cortex.

Each bundle is surrounded by a special envelope of parenchyma, which in most cases is thicker in those near the periphery than in those near the vascular-bundle ring. In those nearest the ring this parenchyma is scarcely, if at all, distinct on the inside from the medullary ray opposite which the bundle stands. But on the outside it is quite distinct from the surrounding parenchyma, and its elements have a concentric arrangement. In those farthest from the ring the bundle is surrounded by parenchyma on all sides, the volume of which has evidently increased, while the concentric arrangement is still retained (fig. 6, *cp*). In some of the latter an additional feature is met with in the form of a second outer envelope of parenchyma of greater thickness than the first, whose elements are in some instances arranged in radial rows, and become elongated in the same direction

* *Vide infra*, p. 95.

(fig. 6, *rp*). On the outside, this layer, whether its cells become radially arranged or not, passes over without a break into the general parenchyma of the radicular tissues or into a peridermal band which abuts on one of the narrow fissures already mentioned (fig. 6, *p*, *f*). In these last cases, however, the peridium and fissure do not completely surround the other tissues, a portion of which are still in organic connexion with the general parenchyma.

Though not entirely free from difficulties, the best explanation of the structure of this part of the fossil seems to be that which has been already assumed, viz., that it consists of a number of roots imbedded in a mass of parenchyma from which their peripheral tissues are not in all cases or wholly separated. On this view the vascular bundle will represent the axile strand, while the layers of parenchyma which envelope it will represent the inner part of the cortex of a root. The characteristics of this parenchyma are not unlike those usually met with in the inner part of the cortex of recent roots *, a fact which is in favour of the view suggested.

Longitudinal sections of the specimen, taken tangentially as near the periphery as possible, show that the rootlets emerge approximatively at right angles, and are therefore cut transversely. Seen in such sections, the structure of the roots is not the same in all cases. In some it agrees with that already described in the transverse sections; but in others it differs, and that in two directions. On the one hand, we have roots with a central collateral vascular bundle surrounded by a tissue which is not differentiated into layers, and which shows no line of separation from the parent tissues. These roots bear some resemblance to those figured and described by Williamson in his monograph of *Stigmaria ficoides*, pl. v. fig. 46. On the other hand, we have roots in which the parenchyma round the vascular bundles is sharply differentiated into distinct layers, which give the whole an appearance not unlike other rootlets figured and described by Williamson on pl. ix. fig. 51 of the same work.

Roots of the latter type are nearer the periphery than those of the former, and indeed seem to be on the point of becoming free. As is shown in fig. 7, the tissues which surround the vascular bundle are arranged from within outwards as follows:—

* Van Tieghem, 'Traité de Botanique,' 2nd ed. p. 674. De Bary, 'Comparative Anatomy,' Engl. ed. pp. 404, 412.

i. Two or three rows of relatively large cells arranged somewhat tangentially immediately round the vascular bundle (Pl. XVII. fig. 7, *a*).

ii. A zone, 8 or 9 cells thick, whose elements are polygonal in shape and have no definite arrangement (fig. 7, *b*). The outermost layer of this zone has some resemblance to a bundle-sheath (fig. 7, *s*), and the innermost layers have black contents.

iii. A zone of thick-walled, apparently sclerenchymatous, elements arranged in some degree tangentially (fig. 7, *c*).

iv. A thin-walled tissue, with irregularly arranged elements, passing into the thick-walled tissue on the inside and into the parent tissues on the outside (fig. 7, *d*).

How many of these layers properly belong to the cortex of the roots cannot be definitely stated; but I am inclined to think the separation would ultimately take place somewhere in the layer last described.

In two of the tangential longitudinal sections of the specimens the xylem and phloem of the roots of this type are seen to be placed transversely to the long axis of the parent stem—a fact which suggests that in them a torsion of the vascular bundle to the extent of 90° has taken place *.

A comparison of the structure of this type of root with that of the others shows some marked differences in the cortical tissues. In spite of this, it is probable that the two forms represent different stages of development only, though no intermediate stages between the one and the other have been found.

General and Comparative Review.

From the preceding description it is obvious that, in this fossil, we have the remains of a plant which was characterized by several peculiarities whose rational explanation is by no means easy. The first question that naturally arises is as to the nature of the part preserved; but even on this a final and direct answer can scarcely be given. It may be taken as certain, however, that it is either a root, aerial stem, or rhizome.

Against the view that it is a root must be set the important fact that there is no trace of the centripetally developed and alternating strands of xylem and phloem so generally character-

* *Vide supra*, p. 93.

istic of the roots of existing plants. Whether in Carboniferous times the existing uniformity of root-structure did or did not prevail may be an open question; but, so far as I can learn, no case other than that of *Stigmaria* has hitherto been adduced as an instance of a root without the centripetally developed xylem and phloem. And even here the authorities are not in agreement. Our own great authority, Williamson*, is "fully satisfied that *Stigmaria*, viewed as an *organ*, is a root." Solms-Laubach †, Schenk ‡, Renault §, and other continental palæobotanists, however, still regard it as a rhizome. I suspect that these divergencies are in some measure due to the fact that, while Williamson looks chiefly to physiological distinctions, the authorities referred to look rather to morphological ones. However this may be, the specimen under description presents no morphological characters suggestive of a root, and I incline therefore to regard it as, morphologically, some form of stem, either aerial or submerged. That it had an erect position may be indicated by the circular arrangement of the vascular bundles, and the uniform development of the enveloping tissues on all sides; but until the acquisition of further examples affords more direct evidence, this point need not be emphasized.

To plant anatomists, no part of the preceding description will be more striking than that of the "enveloping tissues," and especially that portion which contains the structures we are at present disposed to regard as roots. Among recent plants it is known that some species of *Lycopodium*—*L. Selago*, *L. Phlegmaria*, *L. ulicifolium* ‖, for example—and some Ferns—*Angiopteris* and *Marattia* ¶—have roots running in the cortical tissues of the stem, and a similar phenomenon is met with in some Marattiaceous Ferns of Carboniferous age **. In the species of *Lycopodium* and the Ferns referred to, these roots arise from the pericycle of the stem, near its summit in the one case, and from the base of each leaf in the other, originating in one or more initial cells, by

* "Stigmaria ficoides," Palæontographical Society's Publications, 1886, p. 1. The italics are Williamson's.

† 'Einleitung in die Paläophytologie,' p. 296 (Engl. ed. p. 288).

‡ 'Die fossilen Pflanzenreste,' p. 97.

§ 'Cours de Botanique fossile.'

‖ Sachs, 'Text-Book of Botany,' 2nd English ed. p. 462.

¶ Goebel, 'Outlines of Classification and Special Morphology,' English ed. p. 258.

** Schenk, 'Die fossilen Pflanzenreste,' p. 27.

whose divisions the whole of the root-tissues are ultimately built up *. Elaborate details are given by Van Tieghem of the mode of development, but there is nothing in our specimen to indicate that its roots have originated in the way he so carefully describes.

As regards Carboniferous plants, *Psaronius* is perhaps the best known example of a stem with roots running in the cortical tissues. From what is known of its structure †, it is usually regarded as the stem of a Fern, which probably attained arborescent proportions. According to the best authorities, the parenchymatous cortex varies in thickness, and is traversed by numerous roots running nearly perpendicularly downwards. It may be said therefore to bear some resemblance to our specimen. But in *Psaronius* the vascular bundles of the stem are not collateral, and the roots usually have a hexarch or pentarch vascular strand and a cortex which is uniformly and perfectly normal when compared with that of recent plants. On the other hand, as in some of the roots of our specimen, the outer limit of this cortex is not quite sharp, and appears to stand in direct union with the stem-tissue in which it lies. How this last feature has come about has not yet been determined. According to some authorities it is produced by a growing together of the stem and root tissues; but Stenzel ‡ is of opinion that it marks an early stage of root-development, to be followed later by a complete separation from the parent tissue. As is pointed out by Solms-Laubach, this implies a mode of development very different from anything we know to occur in recent Ferns, but it is not without interest in relation to the plant we are dealing with.

It would seem, then, that neither among recent plants nor among the plants of the Coal-Measures hitherto described is there anything which is strictly comparable to this part of the

* Van Tieghem, "Recherches comparative sur l'origine des membres endogènes dans les plantes vasculaires," Ann. d. Sci. nat., Botanique, série vii. tome viii. 1888, pp. 553, 561. Goebel, *loc. cit.* p. 258.

† Russow, 'Betrachtungen über das Leitbundel- und Grundgewebe,' p. 51. Solms-Laubach, *loc. cit.* p. 174 (Engl. ed. p. 171). Schenk, *loc. cit.* p. 48. Williamson, 'Organization of the Fossil Plants of the Coal-Measures.' Parts vii., xii.

‡ This statement is made on the authority of Solms-Laubach, *loc. cit.* p. 175.

stem under consideration. The scantiness of the material prevents the formation of a definite conclusion as to the origin of the radicular tissues, but it proves indisputably that small collateral bundles become separated from the vascular-bundle ring, and that while still near the ring they are imbedded in the pericycle and have no special parenchymatous envelope of their own. On the assumption—which is surely not unreasonable—that the vascular bundles further from the ring have a similar origin, it will follow that as the distance from the bundle-ring increases, the isolated bundles become surrounded by a special envelope of parenchyma, which may be differentiated into distinct layers. So far as *appearances* go, then, they suggest that these root-like structures originated by the separation of collateral bundles from the bundle-ring, accompanied by an active multiplication of the cells of the pericycle. At a further distance from the centre, this activity is still continued and a zone of parenchyma round each bundle becomes more or less clearly distinguishable from the surrounding parenchyma. There is, however, no break in the organic continuity, and even when the special parenchyma is differentiated into concentric and radiating layers, the latter pass over, in many cases, without interruption into the surrounding parenchyma. Whether the formation of periderm and the splitting of the tissues are the last stages by which these structures ultimately become free we cannot say; but such a view would be consistent with all that has been said, and would complete the story suggested by the structure of the radicular tissues.

It scarcely needs to be said that such a mode of origin for structures which are probably roots differs materially from anything that is known to occur in living plants. On this, if on no other account, then, it can only be regarded as a speculative effort to explain the structure and arrangement of the tissues involved, and as such it is here put forward. Nevertheless, it is to be noted that in describing the mode of branching met with in the roots of *Lycopodium clavatum*, Van Tieghem * shows that here, too, branching is preceded by a division of the vascular strand. Not only so, but he states explicitly that when the vascular strand divides unequally, the smaller portion runs for a long time in the cortex of the primitive trunk, nearly parallel to the larger portion, before it acquires its own special

* "Memoir sur la Racine," Ann. d. Sci. nat., Botanique, série v. tome xiii. 1870.

envelope of parenchyma. Hence the above speculation is not altogether unlikely, since something comparable is to be met with in the *Lycopodium* referred to. Moreover, in his Memoirs on the Plants of the Coal-Measures Williamson has figured and described* the division of the vascular tissues in several cases, where the process appears to be in some points similar to that assumed above.

Another detail on which a word may be said is the structure of the vascular strand of these roots. At the first glance, each bears some resemblance to the corresponding structure of a monarch root, such as is met with in *Lycopodium*, *Selaginella*, *Isoëtes*, and *Ophioglossum* †, after a greater or less number of bifurcations, and, according to Williamson, in the rootlets of *Stigmaria* ‡. From what has been said, however, it is clear that, in spite of this superficial resemblance, we have here to do with a collateral bundle and not with a monarch vascular strand in the usual sense of the words. The case of *Stigmaria* is of special interest since the vascular bundles of the appendages are derived from a vascular system, which takes the form of a ring of apparently collateral bundles. But in *Stigmaria* the outgoing bundles are derived, in the first instance §, from the apex of the vascular wedges, where they abut upon the pith, while in the plant before us they appear to be bundles of the original ring, which curve outwards, bodily, into the surrounding tissues. Unless therefore we agree to regard the vascular bundles of the ring as of the monarch type, we can scarcely apply that term to those met with in the radicular tissues. In this connexion, it may be well to mention that although Williamson regards the vascular strand of the appendages of *Stigmaria* as monarch, Solms-Laubach seems to consider it as collateral ‖. If this view should turn out to be correct, the chief difference between the vascular bundles of Stigmarian appendages and those of the roots of our plant will depend on the mode in which, according to Williamson, the former are developed.

Systematic Position.

Where so many points are doubtful, it is clearly impossible to speak definitely of the systematic position of this plant.

* 'Organization of the Fossil Plants of the Coal-Measures.' Parts iii., xi., xvii.

† Van Tieghem, *loc. cit.*

‡ "Stigmaria ficoides," Palæontographical Society's Publications, vol. xl. for 1886.

§ Williamson, "Stigmaria ficoides," p. 22, note.

‖ 'Einleitung in die Paläophytologie,' p. 284 (Engl. ed. p. 277).

The absence of Monocotyledons and Dicotyledons from the Carboniferous Flora, as at present known, may perhaps be taken as *prima facie* evidence that it does not belong to either of these groups. The scalariform tracheæ point in the same direction, and would seem to indicate further that it can scarcely be placed among the Gymnosperms. In other words, the little evidence there is on the subject points to the Vascular Cryptogams as the plants to which the specimen most nearly approaches.

The similarity of some of the emerging roots to the rootlets of *Stigmaria* described by Williamson may be an indication of some affinity with that fossil; but in view of the uniformity which usually prevails in root-structure through the whole vegetable kingdom, much weight cannot be attached to this feature. The character of the vascular bundle, simulating as it does the appearance of a monarch vascular strand, might be also held to point in the direction of the *Lycopodinæ*; but from what has been already said, the bundle is rather collateral and does not originate in the same manner as those of the true monarch type found in that group. Moreover, the nature and arrangement of the vascular bundles of the stem are very different from anything known to occur in the *Lycopodinæ*.

If we turn to the *Filicineæ*, we find in certain members some approach to one or more of the peculiarities met with in our fossil. In the stems of *Osmunda*, *Botrychium*, and *Ophioglossum* the vascular bundles are collateral and are arranged in the form of a ring round a central pith. But in *Osmunda* the phloem parts are fused laterally into a continuous ring *, while in *Botrychium* a similar fusion occurs both in the xylem and the phloem †. In *Ophioglossum* we have no fusion in either part of the bundles, and hence in this respect there is some resemblance between it and the fossil. *Ophioglossum* is further interesting from the fact that a root arises normally beneath each leaf, and the leaf-trace, after passing down the central cylinder, is said to bend out into the root ‡. On the other hand, each bundle in *Ophioglossum* is said to have its own special pericycle and endoderm §, while in our plant the pericycle is common to the whole bundle-ring and no endoderm has yet been made out.

As to the presence of roots in the cortex, it has already been

* Van Tieghem, 'Traité de Botainque,' 1st ed. p. 1243.

† *Idem*, p. 1262.

‡ Goebel, 'Outlines of Classification and Special Morphology,' Engl. ed. p. 250.

§ Van Tieghem, 'Traité de Botanique,' 2nd ed. p. 1393.

mentioned that in the *Marattiaceæ* some such phenomenon is met with as well as in some of the *Lycopodiaceæ* *. This feature therefore is equally consistent with affinities with the *Filicineæ* and *Lycopodinæ*. The structure of the vascular strand of the roots and the mode in which it separates from the vascular ring of the stem are so peculiar, that no inference can be drawn from them, though Goebel's brief reference to the course of the bundles in *Ophioglossum* suggests a parallelism between the course of the bundles in the two cases.

To estimate the value of these agreements and differences is no easy task, especially when they are based on the one side upon sections taken from a single specimen only, and perhaps the safest course is to leave the question of affinity an open one. In a conversation I had with Prof. Williamson, when my reflections had reached this point, he was good enough to express himself freely upon the specimen, and stated that in his view its affinities were with *Stigmaria*, of which it may be a new type. The references to *Stigmaria* in what has preceded are sufficient to show in what points the two plants agree, and how far these support an opinion which is otherwise entitled to so much weight. For myself, the differences seem to be sufficient to warrant a suspension of judgment until further knowledge is forthcoming; and if I do not accept Prof. Williamson's suggestion as freely as it was offered, it is in the hope that such knowledge will not long be wanting.

The advisability, or otherwise, of giving the plant a name has been carefully considered, and an attempt made to assess the relative disadvantages of a name and no name, for it is clear that a choice between two evils is alone possible. I have decided in favour of a provisional designation being given it, and propose that it shall be known as *Tylophora* † *radiculosa*. The generic name is derived from the external markings, while the specific refers to the roots, which are so conspicuous a feature in its structure. Hence the combination is not an unsuitable one, while its parts are sufficiently neutral to avoid misleading suggestions.

For the figures which accompany this paper I am indebted to Mr. James Lomax and Mr. F. C. Moore, B.Sc. In spite of unusual difficulties, the former succeeded in getting photographs of the sections from which all the figures have been taken except fig. 2. This is based partly upon a photograph, and partly upon a diagrammatic drawing of the whole section, made by Mr. Moore.

* *Ante*, p. 96. † Τύλος.

EXPLANATION OF THE PLATES.

Plate XVI.

Fig. 1. External aspect of the fossil.
- *a.* Tubercles.

Fig. 2. Transverse section.
- *p.* Pith.
- *r.* Projecting roots.
- *vb.* Vascular bundles of the ring.
- *ab.* Vascular bundles going to the appendages.
- *l.* Line of union of true cortex to the radicular tissues.
- *i.* Intrusions of true cortex into the radicular tissues.
- *c.* Intrusion of radicular tissues into the true cortex.
- *a, b, e, d.* Successive layers of the true cortex.

Plate XVII.

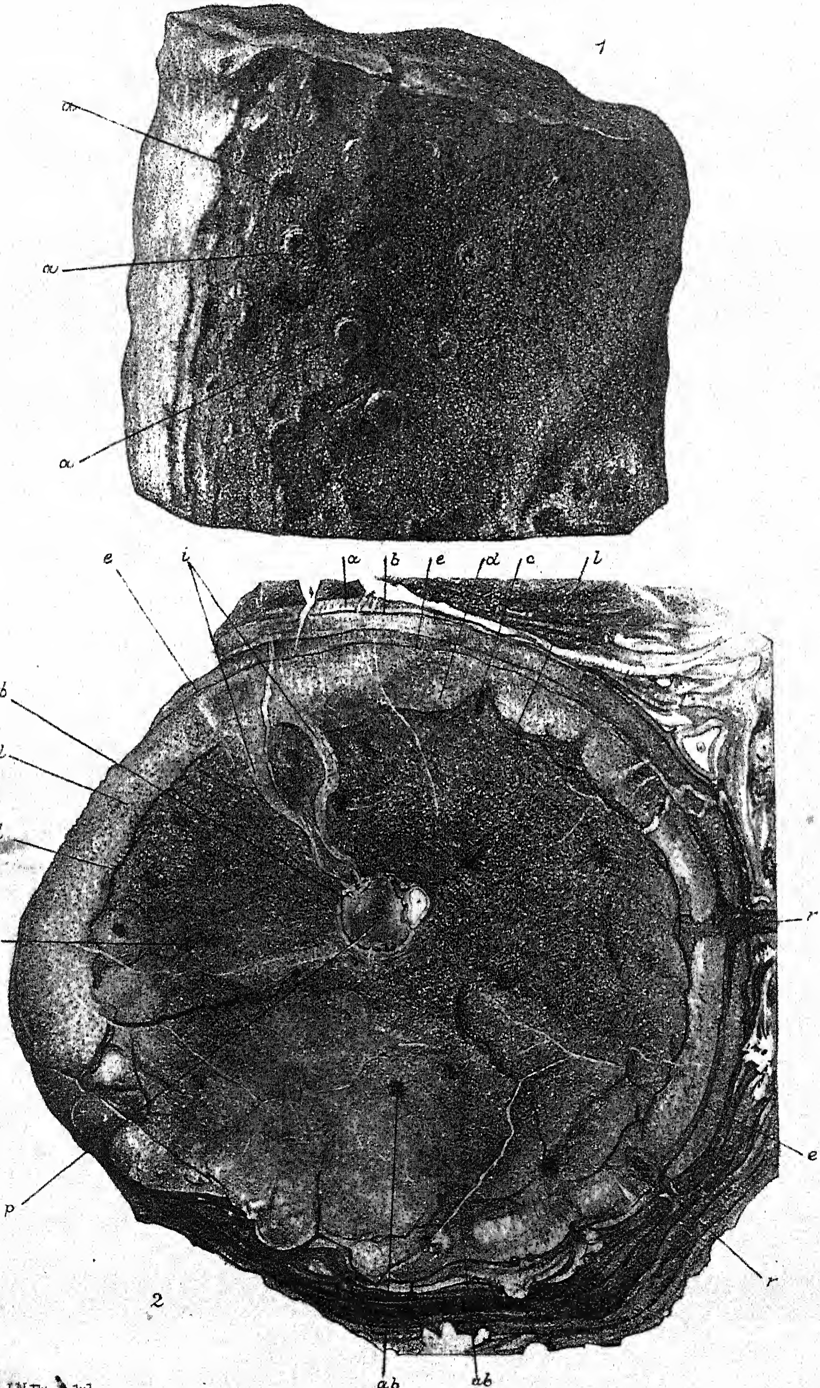
Fig. 3. Portion of the vascular-bundle ring &c., enlarged.
- *p.* Pith.
- *vb.* Vascular bundle.
- *mr.* Medullary ray.
- *c.* Procambium or cambium.
- *x.* Xylem.
- *ph.* Phloem.
- *pc.* Pericycle.
- *iz.* Internal zone of radicular tissues.

Fig. 4. Portion of vascular-bundle ring, less enlarged than in fig. 4, and showing in addition—
- *ab.* Vascular bundles leaving the ring.
- *pc.* Pericycle, a portion of which accompanies the retreating bundles.
- Other references as in preceding figures.

Fig. 5. Inner portion of true cortex.
- *a.* Third layer from surface.
- *b.* Fourth layer from surface-periderm.
- *c.* Fifth layer from surface abutting on the radicular tissues.

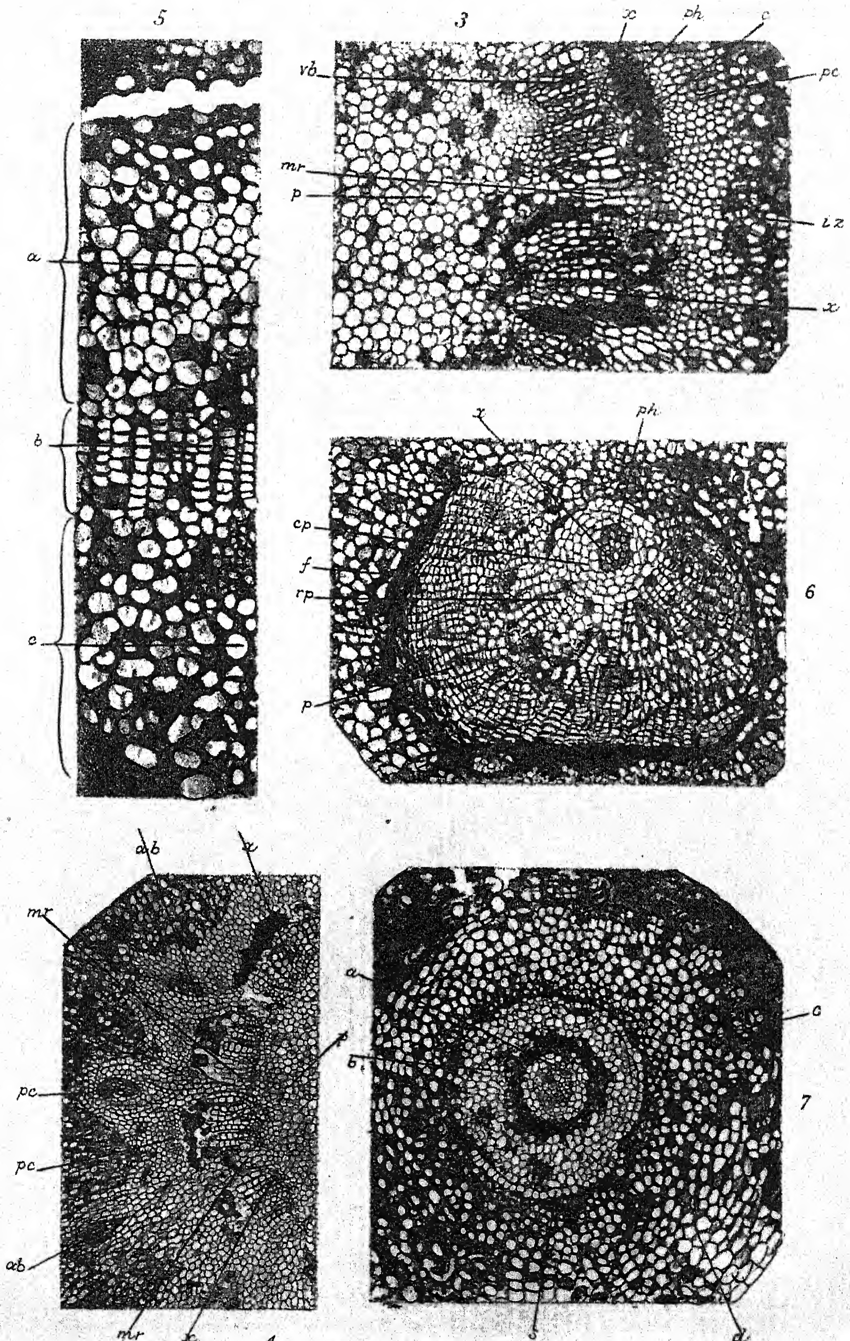
Fig. 6. Enlarged view of one of the roots of the radicular tissues.
- *x, ph.* Xylem and phloem of the vascular bundle.
- *cp.* Concentric parenchyma.
- *rp.* Radial parenchyma.
- *p.* Periderm—an incomplete ring.
- *f.* Fissure.

Fig. 7. Section of root just before it becomes free.
- *a.* Thin layer of parenchyma immediately surrounding the vascular bundle.
- *b.* Thicker layer of larger, irregularly arranged cells.
- *c.* Thick-walled, perhaps sclerenchymatous layer.
- *d.* Outermost layer of thin-walled cells.
- *s.* Sheath-like layer.



J.N.Fitch lith.

NEW FOSSIL PLANT FROM COAL MEASURES



J.N.Fitch lith.

NEW FOSSIL PLANT FROM COAL MEASURES.

A Contribution to the Freshwater Algæ of West Ireland.

By Wm. West, F.L.S.

[Read 5th December, 1891.]

(Plates XVIII.-XXIV.)

During the July of 1890 I went to the West of Ireland and made some hundreds of gatherings of Algæ from this most prolific district. The localities were varied as much as possible considering the limited time that I had, yet there was a lack of material from the more elevated parts of the district, on account of the unfavourable weather which prevailed preventing any ascent of the higher mountains. Notwithstanding this slight drawback, the collections have proved to be extremely rich in species, some of those which are usually considered rare proving to be locally common, while a number of species and varieties are entirely new.

A few good gatherings were made in and near lakes both north and south of Westport. The small lakes and moor-pools of South-west Mayo towards Leenane, as well as those of Galway towards Clifden, were also found to be rich localities; but the best-yielding district was undoubtedly that traversed between Clifden and Roundstone, and thence through Connemara by way of Ballynahinch and Glendalough to Oughterard, the land here being studded with innumerable small lakes. A walk from Ballyvaughan over the terraced limestone hills of Burren in N. Clare to Gort yielded hardly any Algæ. A few days spent in the neighbourhood of Muckross proved that district to be well worth investigating. These were the only places in which I collected, except that one small bottle was filled from the river at Mallow while waiting for a train.

In the August of 1891 I again went to the S.W. of Ireland; although the weather was most unfavourable, the rain seldom ceasing, still a very large number of gatherings were made. Many species were obtained from pools and other places near the Lower Lake of Killarney and O'Sullivan's Cascade. Some excellent gatherings were made on Carrantuohill, especially to the S.E. and W. of the summit, and between it and Glen Caragh. Between Glen Caragh and Glengarriff, going past Lough Brin and through

Kenmare, some good species were collected. Perhaps the best gatherings, however, were made during a walk down Bantry Bay, past the foot of Sugar Loaf mountain, through Adrigole, past the base of Hungry Hill to Castletown, and from small lakes near the coast S.W. of the latter locality. In returning to Kenmare a brief stay was made at Cloonee Lough in driving rain, which resulted in the collection of some interesting species.

Washings and squeezings from submerged plants such as the following were found to yield many of the smaller species:—*Nymphæa*, *Nuphar*, *Myriophyllum*, *Ceratophyllum*, *Utricularia*, *Eriocaulon*, *Lobelia*, *Callitriche*, *Scirpus fluitans*, *Chara*, *Nitella*, *Sphagnum subsecundum* var. *contortum*, *S. cuspidatum* var. *plumosum*, *Hypnum scorpioides*, *H. exannulatum*, *Rhynchostegium ruscifolium*, *Scapania resupinata*, *Dumortiera irrigua*, and *Aneura multifida*.

I am greatly indebted to my son G. S. West (National Scholar in Biology), who has assisted me most ably in preparing this paper, for without his valuable help its appearance would certainly have been considerably delayed. I have also to thank him for his careful work in the execution of the Plates. My son Wm. West has also rendered considerable help in the literary work of this paper.

As the collections were practically all made in two distinctly separate districts of the W. of Ireland, the prefixed Roman numerals I. and II. are here used to denote the Northern (Galway and Mayo) and Southern (Kerry and Cork) districts respectively.

One dagger (†) prefixed to a species indicates that it is new to the British Isles as far as I can ascertain; two daggers (††) indicate that it is hitherto undescribed. Asterisks denote subspecies.

Although the list is very extensive and has entailed a great amount of work, I do not consider the material to be exhausted.

A very interesting feature of these gatherings has been the refinding of a large number of the species previously found by Archer, many of which are from other districts.

Summary of Species, Varieties, and Forms observed.

Genera.	No. of species.	No. of subspecies.	No. of varieties.	No. of forms.
Batrachospermum	2			
Coleochæte	2			
Bulbochæte	3			
Œdogonium	13	....	2	1
Conferva	4	....	1	
Cladophora	1			
Draparnaldia	1	....	1	
Chætophora	1			
Aphanochæte	2			
Prasiola	1			
Hormiscia	1			
Ulothrix	1			
Trentepohlia	1			
Mougeotia	4			
Spirogyra	5			
Zygnema	3	....	....	2
Gonatozygon	5			
Sphærozosma	4			
Spondylosium	4			
Onychonema	1			
Hyalotheca	3	....	1	1
Gymnozyga	1			
Desmidium	3			
Docidium	2	....	1	
Pleurotænium	7	....	4	
Closterium	37	....	2	2
Penium	19	....	9	5
Cylindrocystis	3	1		
Mesotænium	3	....	1	
Tetmemorus	3	....	2	1
Spirotænia	3			
Micrasterias	13	....	2	5
Euastrum	26	1	7	2
Cosmarium	108	2	19	9
Xanthidium	9	....	5	1
Arthrodesmus	10	....	3	1
Staurastrum	81	2	22	4
Eudorina	1			
Pandorina	1			
Gonium	1			
Pediastrum	7	....	1	
Selenastrum	1			
Sorastrum	1			
Staurogenia	2			
Cœlastrum	5			
Sciadium	1			
Ophiocytium	1			
Dictyosphærium	1			
Apiocystis	1			
Hydrianum	1			
Nephrocytium	2			

Table (*continued*).

Genera.	No. of species.	No. of subspecies.	No. of varieties.	No. of forms.
Oocystis	3			
Porphyridium	1			
Pleurococcus	2			
Acanthococcus	2			
Chlorococcum	2	....	1	
Glœocystis	4			
Eremosphæra	1			
Botryococcus	2			
Urococcus	1			
Rhaphidium	1	....	1	
Scenedesmus	6	....	4	
Polyedrium	5			
Nostoc	1			
Cylindrospermum	1			
Anabæna	2			
Calothrix	1			
Rivularia	3			
Tolypothrix	2			
Petalonema	1			
Scytonema	2			
Stigonema	2			
Oscillaria	7			
Microcoleus	1			
Lyngbya	1			
Spirulina	2			
Chroococcus	2			
Glœocapsa	3			
Synechococcus	1			
Merismopedia	4			
Tetrapedia	1			
Aphanocapsa	1	....	1	
Glaucocystis	1			
Microcystis	2			
Aphanothece	1			
Cœlosphærium	1			
Cyclotella	2			
Melosira	2			
Surirella	7	....	1	
Cymatopleura	2			
Epithemia	7			
Eunotia	11	....	1	
Ceratoneis	1			
Cymbella	4			
Cocconema	4			
Encyonema	2			
Amphora	1			
Cocconeis	3			
Achnanthidium	2			
Achnanthes	2			
Odontidium	3			
Fragilaria	1			
Diatoma	2			

Table (*continued*).

Genera.	No. of species.	No. of subspecies.	No. of varieties.	No. of forms.
Synedra	8	....	1	
Asterionella	1			
Amphipleura	1			
Nitzschia	8			
Nitzschiella	1			
Navicula	18	....	1	2
Pinnularia	15	....	2	
Frustulia	1			
Pleurosigma	1			
Stauroneis	3	....	....	1
Pleurostaurum	1			
Mastogloia	1			
Gomphonema	9	....	1	
Meridion	2			
Tabellaria	2			
Total	617	6	97	37

The above total number consists of 345 species, 6 subspecies, 78 varieties, and 31 forms of Desmidiaceæ belonging to 21 genera; 128 species, 7 varieties, and 3 forms of Diatomaceæ belonging to 32 genera; the remaining 144 species, 12 varieties, and 3 forms are distributed over 65 genera.

34 species, 7 subspecies, 47 varieties, and 28 forms are here described for the first time.

I. ALGÆ.

Class FLORIDEÆ.

Ord. HELMINTHOCLADIÆ.

1. BATRACHOSPERMUM MONILIFORME, *Roth*. (*Rabh. Fl. Europ. Alg.* iii. p. 405.)

II. Glen Caragh; Mallow.

2. B. VAGUM, *Ag*. (*Rahb. l. c.* p. 406.)

I. Ballynahinch.—II. Torc Mt.

Class CONFERVOIDEÆ HETEROGAMEÆ.

Ord. COLEOCHÆTACEÆ.

1. COLEOCHÆTE SCUTATA, *Bréb*. (*Rabh. Fl. Europ. Alg.* iii p. 390.)

I. Lakes, Clifden to Roundstone, and near Recess.

†2. Coleochæte irregularis, *Prings.* (*Rabh. Fl. Europ. Alg.* p. 390.)

Diam. cell. veget. 12·5–20 μ.

I. Lough Creggan; Roundstone.

Ord. Œdogoniaceæ.

1. Bulbochæte gigantea, *Prings.* (*Wittr. Monog. Œdog.* p. 48.)

Crass. cell. veget............	17–28 μ;	altit. 3–4plo major;	
„ „ androspor.......	23 μ;	„	15 μ;
„ oospor.	67–75 μ;	„	55–62 μ;
„ nannandr.............	10–12·5 μ;	„	30–60 μ;
„ spermogon.	12·5 μ;	„	13 μ.

I. Lough Creggan.

2. B. mirabilis, *Wittr.* (*Monog. Œdog.* p. 50.)

Crass. cell. veget.......	15–20 μ;	altit. 5–6plo major;	
„ oospor.	30 μ;	„	48 μ.

II. Lower Lake of Killarney.

3. B. pygmæa, *Prings. pro parte.* (*Wittr. Monog. Œdog.* p. 52.)

I. Lakes, Clifden to Roundstone.

1. Œdogonium cryptoporum, *Wittr.* (*Monog. Œdog.* p. 7.)

Crass. cell. veget....	7·5–8·5 μ;	altit. 5–8plo major;	
„ „ suffult.	12·5 μ;	„	1½ „ „
„ oogon..........	22·5 μ;	„	20 μ;
„ oospor.	20 μ;	„	16 μ.

I. Roundstone.

Var. vulgare, *Wittr.* (*Monog. Œdog.* p. 7.)

Crass. cell. veget....	5 μ;	altit. 5–6plo major;	
„ oogon.	21–22 μ;	„	15–17·5 μ;
„ oospor.	18–20 μ;	„	14–15 μ.

I. Lough Creggan.

2. Œ. platygynum, *Wittr.* (*Monog. Œdog.* p. 17.)

Crass. cell. veget....	5–8 μ;	altit. 3–5plo major;	
„ oogon.	26–30 μ;	„	16–27 μ;
„ oospor.	23 μ;	„	13 μ.

I. Ballynahinch; Lakes, Clifden to Roundstone.—II. Castletown.

††Forma MAJOR. (Pl. XVIII. fig. 1.)

Crass. cell. veget.......	11–11·5 μ;	altit. 2–3plo major;
„ „ suffult. ...	12·5 μ;	„ „ „
„ oogon.	26 μ;	„ 16 μ;
„ oospor.	23 μ;	„ 13 μ.

I. Ballynahinch.

†3. Œdogonium longicolle, *Nord.* (*Alg. Aquæ dulc. et Char. Sandvic.* p. 20, tab. 2. figs. 11–12), var. senegalense, *Nord.* (*De Alg. et Char.* i. p. 13, tab. 16. fig. 23).

Crass. cell. veget....	4·5 μ;	altit. 3plo major;
„ oogon.	16–18 μ;	„ 18–23 μ;
„ oospor.	16 μ;	„ 11 μ.

II. Upper Lake of Killarney.

4. Œ. undulatum, *A. Br.* (*Wittr. Monog. Œdog.* p. 20.)

I. Derryclare Lough; Lakes, Clifden to Roundstone; near Oughterard.

5. Œ. Braunii, *Kuetz.* (*Wittr. Monog. Œdog.* p. 22.)

Crass. cell. veget....	12·5–13·5 μ;	altit. 4plo major;
„ oogon.........	31 μ;	„ 35 μ;
„ oospor.	27·5 μ;	„ 30 μ.

I. Clifden.

†6. Œ. suecicum, *Wittr.* (*Monog. Œdog.* p. 30.) (Pl. XVIII. fig. 2.)

Crass. cell. veget.......	11–12 μ;	altit. 6–7plo major;
„ oogon............	34 μ;	„ 42 μ
„ oospor. (s. spin.)	28 μ;	„ 39 μ.

I. Ballynahinch.

††7. Œ. pilosporum, nov. sp. (Pl. XVIII. fig. 3.)

Œ. (dioicum?); oogonis singulis oblongo-ellipsoideis inflatis, utroque polo paullum productis; oosporis subglobosis, membranis crassis et dense pilosis cum pilis brevibus; cellula basali simile aliis.

Crass. cell. veget.........	11–12 μ;	altit. 5–6plo major;
„ oogon.	23 μ;	„ 48 μ;
„ oospor. (sine acul.)	17 μ;	„ 18 μ;
„ „ (cum „)	19 μ;	„ 21 μ.
„ membr. oospor....	2 μ.	

I. Arderry Lough.

The oospores of this species showed indications of an apical operculum, but an open one was not seen.

8. ŒDOGONIUM CALCAREUM, *Cleve.* (*Wittr. Monog. Œdog.* p. 32.)

I. Lough Aunierin; Ballynahinch.

9. Œ. sp.

Crass. cell. veget...... 9·5–10 μ; altit. $3\frac{1}{2}$–5plo major;
„ oogon. .... 30 μ; „ 28 μ;
„ oospor. .... 26 μ; „ 25 μ.
„ membr. oospor. 2·5–3 μ.

II. Upper Lake of Killarney.

This is probably *Œ. pachydermatosporum*, Nord. (Alg. Sandv. p. 21, tab. 2. figs. 13–15), but it was only seen in small quantity; the oogonia observed were solitary and had a superior pore; the oospores had the thick membrane of this species.

10. Œ. PRINGSHEIMII, *Cram.* (*Wittr. Monog. Œdog.* p. 33.)

Crass. cell. veget.... 14–16 μ; altit. $2\frac{1}{2}$–$3\frac{1}{2}$plo major;
„ oogon. ...... 37–40 μ; „ 37–42 μ;
„ oospor. ...... 32 μ; „ 32 μ.

I. Ballynahinch.

11. Œ. PUNCTATOSTRIATUM, *De Bary.* (*Wittr. Monog. Œdog.* p. 34.)

I. Lough Derryclare; Lakes, Clifden to Roundstone.—II. Upper Lake of Killarney.

12. Œ. LONDINENSE, *Wittr.* (*Monog. Œdog.* p. 39.)

Crass. cell. veget.... 10·5–11·5 μ; altit. 4–5plo major;
„ oospor. ...... 35 μ; „ 35 μ.

I. Derryclare Lough.

††Var. COMPRESSUM, nov. var. (Pl. XVIII. figs. 10–12.)

Var. oogoniis singulis compresso-globosis; oosporis compresso-globosis, membrana glabra punctatave; cellulis vegetativis minoribus.

Crass. cell. veget.... 9–10 μ; altit. $2\frac{1}{2}$–$4\frac{1}{2}$plo major;
„ oogon. ...... 32–37 μ; „ 25–27 μ;
„ oospor. ...... 30–32 μ; „ 22–25 μ.

II. Upper Lake of Killarney.

13. Œ. sp.

Membrana distincte punctata.

Crass. cell. veget. 30 μ; altit. 1–$1\frac{1}{2}$plo major.

II. Lower Lake of Killarney.

Class Confervoideæ Isogamæ.

Ord. Confervaceæ.

†1. Conferva stagnorum, *Kuetz.* (*Wille, Hvil. hos Conf.* p. 20, tab. 1. figs. 12–27, tab. 2. fig. 50.)

Crass. fil. 8·5–10 μ.

I. Near Westport; Ballynahinch.—II. Upper Lake of Killarney.

†2. C. pachyderma, *Wille.* (*Hvil. hos Conf.* p. 20, tab. 1. figs. 28–35.)

I. Derryclare Lough.—II. 8 m. S. of Kenmare.

3. C. bombycina, *Ag.*, *genuina, *Wille.* (*Hvil. hos Conf.* p. 20, tab. 1. figs. 41–43, tab. 2. figs. 51–54.)

Crass. fil. 8·5 μ.

I. Ballynahinch; near Westport; Arderry Lough.

**minor, *Wille.* (*Hvil. hos Conf.* p. 21, tab. 1. figs. 36–40, tab. 2. figs. 55, 56.)

Crass. fil. 5–7·5 μ.

I. Athry Lough; Ballynahinch; Creggan Lough.

†4. C. abbreviata, *Wille.* (*Hvil. hos Conf.* p. 21, tab. 2. figs. 58, 59.)

II. Cloonee Lough.

1. Cladophora flavescens, *Ag.* [C. glomerata f. flavescens, *Rabh. Fl. Europ. Alg.* iii. p. 342.]

I. Near Westport.

1. Draparnaldia plumosa, *Ag.* (*Rabh. Fl. Europ. Alg.* iii. p. 382.)

II. Lower Lake of Killarney.

Var. pulchella, *Rabh. in Fl. Europ. Alg.* iii. p. 382.

I. Near Leenane.

1. Chætophora pisiformis, *Ag.* (*Rabh. l. c.* p. 383.)

I. Baheh Loughs.

1. Aphanochæte globosa, *Wolle.* [Herposteiron globosa, *Nord.* (*Alg. Sandvic.* p. 23, tab. 2. figs. 22–23).]

II. Cromagloun; Lower Lake of Killarney; Glengarriff.

2. Aphanochæte repens, *A. Br.* (*Rabh. Fl. Europ. Alg.* iii. p. 391.)
II. Carrantuohill.

Ord. Ulvaceæ.

1. Prasiola furfuracea, *Menegh.* (*Rabh. Fl. Europ. Alg.* iii. p. 309.)
I. Roundstone.

Ord. Ulotrichaceæ.

1. Hormiscia bicolor, *Cooke.* (*Br. Fr. Wat. Alg.* p. 181, pl. 70. fig. 7.)
II. Lower Lake of Killarney.

1. Ulothrix radicans, *Kuetz.* (*Rabh. Fl. Europ. Alg.* iii. p. 367.)
II. Kenmare Street; Castletown.

Ord. Chroolepideæ.

1. Trentepohlia aurea, *Mart.* [Chroolepus aureus, *Kuetz.* (*Rabh. l. c.* p. 371.)]
II. Torc Mt.

Class Conjugatæ.

Ord. Mesocarpeæ.

1. Mougeotia parvula, *Hass.* [Mesocarpus parvulus, *De Bary.* (*Rabh. Fl. Europ. Alg.* iii. p. 257.)]
Crass. cell. veget. 11–12 μ (7plo longioribus); long. spor. 24 μ; lat. spor. 18 μ.
II. Lough Guitane.

2. M. capucina, *Ag.* [Staurospermum capucinum, *Kuetz.* (*Rabh. Fl. Europ. Alg.* iii. p. 259.)]
I. Kylemore; Ballynahinch.

3. M. viridis, *Wittr.* (*Om Gotl. och Ol. Sotv. Alg.* p. 39.)
I. Oughterard.

†4. M. elegantula, *Wittr.* (*Om Gotl. och Ol. Sotv. Alg.* p. 40, tab. 3. figs. 5–8.)

††Forma MICROSPORA. (Pl. XVIII. fig. 17.)
Crass. cell. veget. 4 μ (16plo longioribus); long. spor. 18 μ.
I. Creggan Lough.

Ord. ZYGNEMACEÆ.

1. SPIROGYRA BELLIS, *Crouan*. (*Petit, Spir. des Environs de Paris*, p. 31, tab. 10. figs. 1–3.)
Crass. cell. veget. 56–60 μ ($3\frac{1}{2}$–4plo longioribus); diam. zygosp. 72–80 μ; crass. zygosp. 50 μ.
II. Water-lily pool near the Lower Lake of Killarney.

2. S. VARIANS, *Kuetz*. (*Petit, l. c.* p. 19, tab. 4. figs. 1–8.)
Forma zygosporis diametro $1\frac{1}{2}$plo longus.
II. Cloonee Lough.

3. S. CATENÆFORMIS, *Kuetz*. (*Petit, l. c.* p. 17, tab. 3. figs. 9–12.)
Crass. cell. veget. 20 μ; long. zygosp. 47–60 μ; lat. zygosp. 22–24 μ.
I. Lakes, Clifden to Roundstone.

4. S. TENUISSIMA, *Kuetz*. (*Petit, l. c.* p. 6, tab. 1. figs. 1–3.)
Crass. cell. veget. 14–15 μ (6plo longioribus); crass. spor. cell. 35 μ; long. spor. cell. 87 μ; crass. zygosp. 27 μ; long. zygosp. 40 μ.
I. Roundstone.

5. S. sp.
Cellulæ diametro (34–40 μ) $2\frac{1}{2}$–$3\frac{1}{2}$plo longioribus, extremitatibus nunquam replicatis, fascia spirali anfractibus $2\frac{1}{2}$–$5\frac{1}{2}$.
Pool, Burren Hills, Co. Clare.

1. ZYGNEMA LEIOSPERMUM, *De Bary*. (*Rabh. Fl. Europ. Alg.* iii. p. 249.)
Forma cum cellulis sterilibus diametro $1\frac{1}{2}$–3plo longioribus.
Crass. cell. veget. 20–21 μ; long. $1\frac{1}{2}$–3plo major; diam. zygosp. 25–27·5 μ.
II. Glen Caragh.

††Forma MINOR.
Forma cum cellulis sterilibus et zygosporis parvioribus.

Crass. cell. veget. 16–17 μ; long. 2–$2\frac{1}{2}$plo major; diam. zygosp. 20–23 μ.

II. Cloonee Lough.

††Forma MEGASPORA. (Pl. XVIII. figs. 4–5.)

Forma sporis multum largioribus.

Crass. cell. veget. 27–28 μ; diam. zygosp. 40–45 μ.

I. Lough Shindilla.

2. ZYGNEMA, sp.

Cellulæ diametro (18–20 μ) 2–3plo longioribus; diam. cell. veget. cum vag. 35–40 μ.

I. Lakes, Clifden to Roundstone.

††3. Z. (ZYGOGONIUM) MOMONIENSE, nov. sp. (Pl. XXIV. fig. 26.)

Z. cellulis sterilibus diametro $1\frac{1}{2}$–2plo longius, tubo connexivo multe inflato; zygosporis late ellipticis (axe longiori parallelo ad filamentos), membrana glabra.

Crass. cell. veget. 20–22 μ; long $1\frac{1}{2}$–2plo major; long. zygosp. 30–33 μ; lat. 25–27 μ.

II. Castletown.

This species differs from *Z. Ralfsii*, De Bary, in its larger size, its shorter sterile cells, and its much larger, differently shaped zygospores.

Ord. DESMIDIACEÆ.

1. GONATOZYGON RALFSII, *De Bary*. (*Cooke, Brit. Desm.* p. 2, tab. 1. fig. 1.)

I. Near Westport; near Recess; Baheh Loughs.—II. Muckross; Glengarriff.

2. G. BREBISSONII, *De Bary*. (*Cooke, Brit. Desm.* p. 2, tab. 1. fig. 2.)

Long. 157 μ; lat. 9 μ; lat. apic. 7 μ.

I. Near Westport; Baheh Loughs; Lakes, Clifden to Roundstone; Roundstone; Lough Aunierin; Athry Lough.—II. Lough Guitane; Upper and Lower Lakes of Killarney; Adrigole; Castletown; Glengarriff; Carrantuohill; Cloonee Lough.

3. G. MINUTUM, *West*. (*Fr. Wat. Alg. of N. Wales*, p. 282, tab. 5. fig. 1.)

Long. 62–85 μ; lat. 3–5 μ; lat. apic. 3–4 μ.

I. Roundstone; Ballynahinch; Lakes E. of Lough Bofin; Athry Lough.—II. Lough Guitane; near Lough Brin.

4. GONATOZYGON KINAHANI, *Rabh.* (*Fl. Europ. Alg.* iii. p. 156.)

Long. 232 μ; lat. 12·5 μ; lat. apic. 12·5 μ.

I. Lakes near Recess; Ballynahinch.

5. G. LÆVE, *Hilse.* [G. læve, *West* (*Fr. Wat. Alg. of N. Yorks., in Journ. Bot.* Oct. 1889, tab. 291. fig. 6).]

I. Clifden; Lough Shannacloontippen; Derryclare Lough.—II. Lough Guitane; near Lough Brin.

1. SPHÆROZOSMA VERTEBRATUM, *Ralfs in Brit. Desm.* p. 65, tab. 6. fig. 1.

I. Derryclare Lough.—II. Lough Guitane.

†2. S. AUBERTIANUM, *West.* (*Fr. Wat. Alg. of Maine, in Journ. Bot.* July 1889, p. 2; Oct. 1889, tab. 291. fig. 17). (Pl. XIX. fig. 1.)

Long. 17·5–19 μ; lat. 20–21 μ; lat. isthm. 5–6 μ.

I. Derryclare Lough.

3. S. EXCAVATUM, *Ralfs.* (*Brit. Desm.* p. 67, tab. 6. fig. 2.)

I. Near Westport; Lakes near Recess; Baheh Loughs; Roundstone; Athry Lough; Letereen Lough; Ballynahinch; Lough Creggan; Lakes, Clifden to Roundstone; Lough Derryclare; small lakes, east of Lough Bofin; Lough Oorid; Lough Shannacloontippen.—II. Muckross; Lough Guitane; Upper and Lower Lakes of Killarney; Carrantuohill; Adrigole; near Lough Brin.

4. S. GRANULATUM, *Roy et Biss.* (*Jap. Desm. in Journ. Bot.* July & Aug. 1886, p. 242, tab. 268. fig. 17.)

I. Lakes, Clifden to Roundstone; Derryclare Lough; Clifden.—II. Lough Guitane; Muckross.

1. SPONDYLOSIUM PULCHELLUM, *Arch.* (*Pritch. Infus.* ed. 1861, p. 724, tab. 3. fig. 10.)

Long. 13–16 μ; lat. ad bas. semicell. 14–16 μ; lat. ad apic. 7–8 μ; lat. isthm. 3·5–4·5 μ; crass. 7–8 μ.

I. Ballynahinch; Clifden; Lakes, Clifden to Roundstone.—II. Glen Caragh; Carrantuohill.

††2. S. TETRAGONUM, nov. sp. (Pl. XIX. fig. 2.)

Sp. filis tortis, sine vagina mucosa; cellulæ diametro paulo

longius, apicibus truncatis, angulis rotundatis, leviter et latissime constrictæ, lateribus rotundatis; a vertice visæ ellipticæ; a latere visæ oblongæ, leviter constrictæ.

Long. 8·5–10 μ; lat. 10 μ; lat. isthm. 8 μ; crass. 6 μ.

I. Kylemore.

3. SPHÆROZOSMA PYGMÆUM, *nob.* [Sphærozosma pygmæum, *Cooke* (*Brit. Desm.* p. 5, pl. 2. fig. 5), non *Rabh.* (*Fl. Eur. Alg.* iii. p. 150).]

I. Near Westport.

The Irish specimens seen had no mucous sheath; those seen from Mickle Fell (Freshwater Algæ of N. Yorks. in Journ. Bot. Oct. 1889) had a sheath 11 μ in diameter.

†4. S. PULCHRUM, *Arch.*, var. TRIQUETRUM, *Lund* (*Desm. Suec.* p. 93). (Pl. XIX. fig. 3.)

Long. cell. 20–22 μ; lat. 28–30 μ; lat. isthm. 22–27 μ.

I. Lakes, Clifden to Roundstone.

1. ONYCHONEMA FILIFORME, *Roy et Biss.* (*Jap. Desm.* p. 242). [O. Nordstedtiana, *Turn.*]

I. Lakes near Recess; Derryclare Lough; Clifden; Roundstone.

1. HYALOTHECA DISSILIENS, *Bréb. in Ralfs, Brit. Desm.* p. 51, tab. 1. fig. 1.

Long. 12·5–15 μ; lat. 19–21 μ; lat. isthm. 14–17 μ; diam. zygosp. 20–33 μ.

I. Near Westport; near Leenane; Ballynahinch (cum zygosp.); Arderry, Oorid, and Derryclare Loughs; Roundstone; near Oughterard (cum zygosp.); Lakes, Clifden to Roundstone; Lakes near Recess (cum zygosp.).—II. Upper and Lower Lakes of Killarney; Carrantuohill; Cromagloun; Sugar Loaf Mt.; Lough Guitane (cum zygosp.); Mallow; near Lough Brin; Glen Caragh; Castletown.

Forma BIDENTULA, *Boldt* (*Desm. från Grönl.* p. 43). [H. dissiliens, *Bréb.*, var. bidentula, *Nord.* (*Norges Desm.* p. 48, tab. 1. fig. 22).]

II. Lough Guitane.

Var. HIANS, *Wolle.* (*Freshw. Alg. of U. S.* p. 21, pl. 54. figs. 14–16.)

I. Clifden.

2. Hyalotheca mucosa, *Ehrenb.* (*Ralfs*, *Brit. Desm.* p. 53, tab. 1. fig. 2.)

I. Near Oughterard; Derryclare Lough.—II. Muckross; Carrantuohill; Glen Caragh.

3. H. undulata, *Nord. in Nord. et Wittr. Alg. Exsic.* no. 248.

Long. cell. 15–17·5 μ; lat. 7·5–8 μ; lat. isthm. 6·5–7·5 μ; diam. fil. cum vag. 25 μ.

I. Ballynahinch; Roundstone.—II. Upper Lake of Killarney; Lough Guitane; Adrigole.

1. Gymnozyga moniliformis, *Ehrenb.* [Bambusina Brebissonii, *Kuetz.*; Didymoprium Borreri, *Ralfs*.]

Long. cell. 25–30 μ; lat. ad bas. semicell. 17·5–22·5 μ; lat. ad apic. 15·2–17·5 μ; long. zygosp. 25–35 μ; lat. zygosp. 20–24 μ.

I. Near Westport; Ballynahinch; Lakes near Recess (cum zygosp.); near Oughterard; Arderry, Oorid, and Derryclare Loughs; near Leenane; Kylemore; Lakes, Clifden to Roundstone.—II. Torc Mt.; Cromagloun; Upper and Lower Lakes of Killarney; Glen Caragh; Castletown; Glengarriff; Sugar Loaf Mt.

1. Desmidium cylindricum, *Grev.* [Didymoprium Grevillei, *Ralfs* (*Brit. Desm.* p. 57, tab. 2).]

Long. 22–25 μ; lat. 49–52 μ; lat. isthm. 40–42 μ; lat. apic. 37–40 μ; crass. 35–40 μ.

I. Ballynahinch (cum zygosp.); Arderry Lough; near Oughterard; Lakes near Recess; Lakes, Clifden to Roundstone; Roundstone.—II. Torc Mt.; Sugar Loaf Mt.; Castletown; Adrigole; Glengarriff.

2. D. Swartzii, *Ag.* (*Ralfs*, *Brit. Desm.* p. 61, tab. 4.)

I. Near Westport; Ballynahinch; Lakes, Clifden to Roundstone; near Oughterard; near Leenane; Lough Shannacloontippen; Kylemore.—II. Cromagloun; Clogerheen; near Lough Brin; Sugar Loaf Mt.; Adrigole; Glengarriff.

3. D. aptogonum, *Bréb.* [Aptogonum Desmidium, *Ralfs* (*Brit. Desm.* p. 64, tab. 23. fig. 1).]

I. Ballynahinch; Roundstone.

1. Docidium baculum, *Bréb. in Ralfs*, *Brit. Desm.* p. 158, tab. 33. fig. 5.

Long. 167–262 μ; lat. ad bas. inflat. 12–13 μ; lat. apic. 8·5–10 μ.

I. Near Westport; Moher Lough; Roundstone; Arderry Lough; Lough Aunierin; Ballynahinch; Lakes, Clifden to Roundstone; Lough Shannacloontippen.—II. Cromagloun; Castletown; Glengarriff; Adrigole.

†2. DOCIDIUM DILATATUM, *Lund.* (*Desm. Suec.* p. 88, tab. 5. fig. 12.) (Pl. XIX. fig. 5.)

Long. 225 μ; lat. ad bas. semicell. 16 μ; lat. ad apic. 13–15 μ.

I. Near Oughterard; Kylemore; Oorid Lough.—II. Cromagloun; Torc Mt.; Glen Caragh.

A form from Cromagloun was noticed which had from 12–13 undulations to each semicell. Long. 262 μ; lat. 13–14 μ. (Pl. XIX. fig. 6.)

††Var. SUBUNDULATUM, nov. var. (Pl. XIX. fig. 7.)

Var. undulis minoribus profundis, cellulis brevioribus, semicellulibus inflatis medio et membrana forte punctata.

Long. 187 μ; lat. 15 μ.

I. Near Oughterard.—II. Glen Caragh.

1. PLEUROTÆNIUM CORONATUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 143.) (Pl. XIX. figs. 8–10.)

Long. 465–560 μ; lat. ad bas. semicell. 42–58 μ; lat. ad apic. 37–45 μ.

I. Lough Derryclare; Lough Aunierin; Lough Shannacloontippen.

††Var. FLUCTUATUM, nov. var. (Pl. XIX. fig. 11.)

P. diametro 15–16plo longius; semicellulis non angustis polos versus, undulatis in ambitu toto.

Long. 670 μ; lat. ad bas. inflat. 55 μ; lat. ad med. semicell. 43 μ; lat. ad apic. 50 μ.

I. Lough Aunierin.

††Var. ROBUSTUM, nov. var. (Pl. XIX. fig. 12.)

P. circiter diametro 8plo longius; semicellulis cylindricis, leviter subundulatis lateribus, contractis distincte ad apicem extremum.

Long. 460 μ; lat. ad bas. inflat. 57 μ; lat. ad med. semicell. 55 μ; lat. ad apic. 48 μ.

I. Lough Derryclare.

Var. NODULOSUM (*Bréb.*), *nob.* [Docidium coronatum, *Bréb.*, var. nodulosum (*Bréb.*), *Roy* (*Fr. Wat. Alg. of Enbridge Lake and vicinity, in Journ. Bot.* Nov. 1890).]

II. Cloonee Lough; 8 m. S. of Kenmare.

In a gathering from near Paris, recently examined, an intermediate form between *P. coronatum* and var. *nodulosum* was abundant.

2. PLEUROTÆNIUM EHRENBERGII, *De Bary.* [Docidium Ehrenbergii, *Ralfs* (*Brit. Desm.* p. 157, tab. 26. fig. 4).]

Long. 262–400 μ; lat. ad bas. semicell. 18–22·5 μ; lat. ad apic. 16–18 μ.

I. Near Westport; Kylemore; Roundstone; Moher Lough; Creggan Lough; near Ballynahinch; Lakes, Clifden to Roundstone; Lakes near Recess; Lough Aunierin; Lough Shannacloontippen; Lough Derryclare; Athry Lough.—II. Lough Guitane; Muckross; Upper and Lower Lakes of Killarney; Glengarriff; near Lough Brin; Castletown; Adrigole; 8 m. S. of Kenmare.

Var. ELONGATUM, *West.* [Docidium Ehrenbergii, *Ralfs*, var. elongatum, *West, in Fr. Wat. Alg. of N. Wales*, p. 284.]

Long. 525 μ; lat. ad bas. inflat. 26 μ; lat. ad apic. 19 μ; lat. ad med. semicell. 21 μ.

I. Clifden.

3. P. CLAVATUM, *De Bary.* [Docidium clavatum, *Kuetz. in Ralfs, Brit. Desm.* p. 156, tab. 26. fig. 3.]

Long. 500 μ; lat. ad bas. inflat. 22 μ; lat. ad apic. 19 μ.

I. Near Westport; Roundstone; Arderry Lough; Lough Aunierin; near Ballynahinch.

4. P. MAXIMUM, *Lund.* (*Desm. Suec.* p. 89.)

Long. 212–300 μ; lat. ad bas. inflat. 18–27 μ; lat. ad apic. 15–20 μ.

I. Arderry, Aunierin, and Oorid Loughs; Ballynahinch.—II. Cromagloun; Glen Caragh; Sugar Loaf Mt.; near Lough Brin; Carrantuohill; Glengarriff.

5. P. TRUNCATUM, *Naeg.* [Docidium truncatum, *Bréb. in Ralfs, Brit. Desm.* p. 156, tab. 26. fig. 2.]

Long. 440–467 μ; lat. ad bas. semicell. 55–60 μ; lat. ad apic. 33–35 μ.

I. Near Westport; near Oughterard; Lakes, Clifden to Roundstone; Aunierin and Moher Loughs.—II. Cromagloun.

6. PLEUROTÆNIUM RECTUM, *Delp.* (*Desm. Subalp.* p. 225, tab. 20. figs. 8–11.)

II. Cromagloun.

†7. P. TRIDENTULUM, *nob.* [Docidium tridentulum (*Wolle, Desm. U. S.* p. 52, pl. 10. fig. 10).]

P. mediocre, circiter trigies longius quam latum; semicellulæ modice inflatæ ad basin; gradatim attenuatæ; ad apices truncatæ, tribus quatuorve spinis brevibus; membrana glabra [vel granulata (var. *granulatum*, nob.)].

††Var. CAPITATUM, nov. var. (Pl. XXIV. fig. 12.)

Var. semicellulæ granulatæ, minores inflatæ ad basin, apicibus subcapitatis et glabris, spinis brevioribus.

Long. 495 μ; lat. ad bas. semicell. 22·5 μ; lat. ad apic. 13·5 μ.

[*Hab.* United States of America.]

This differs from the type in its capitate apices and its shorter spines. Mr. Wolle says in his short description "often granulate." A specimen of the type seen from Harvey Lake, U.S.A., was smooth and agreed with Wolle's figure with the exception of having a much smaller basal inflation.

Var. CAPITATUM, nov. var. Forma membrana minus granulata.

I. Lakes, Clifden to Roundstone.

1. CLOSTERIUM DIDYMOTOCUM, *Corda.* (*Ralfs, Brit. Desm.* p. 168, tab. 28. fig. 7.)

Long. 262–450 μ; lat. 24–45 μ; lat. ad apic. 13–20 μ.

I. Creggan Lough; near Westport; Lakes, Clifden to Roundstone; near Ballynahinch; Kylemore; Roundstone; Oorid Lough; Lough Aunierin; near Oughterard.—II. Carrantuohill; Glen Caragh; Castletown; Sugar Loaf Mt.; Kenmare; Glengarriff; near Lough Brin; Upper Lake of Killarney.

2. C. DIRECTUM, *Arch.* (*Rabh. Fl. Europ. Alg.* iii. p. 127.)

Long. 220–260 μ; lat. 11–12·5 μ; lat. ad apic. 8·5 μ.

I. Ballynahinch.—II. Glen Caragh; Castletown; Carrantuohill.

3. Closterium obtusum, *Bréb.* (*Rabh. Fl. Europ. Alg.* p. 124.)

Long. 75 μ; lat. 12 μ.

I. Kylemore.—II. Carrantuohill.

4. C. lunula, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 163, tab. 27. fig. 1.)

I. Ballynahinch; Creggan Lough; Arderry Lough; Roundstone; near Westport; near Oughterard; Kylemore; Oorid Lough; Lakes E. of Lough Bofin.—II. Lough Guitane; Torc Mt.; Cromagloun; Upper Lake of Killarney; Clogerheen; Glen Caragh; Sugar Loaf Mt.; Castletown; Adrigole; Glengarriff.

5. C. acerosum, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 164, tab. 27. fig. 2.)

I. Athry Lough.—II. Lower Lake of Killarney; Mallow; Glengarriff; Cloonee Lough.

6. C. turgidum, *Ehrenb.* (*Ralfs, l. c.* p. 165, tab. 27. fig. 3.)

I. Lough Creggan; Lough Aunierin.—II. Sugar Loaf Mt.; Castletown; Adrigole.

7. C. Pritchardianum, *Arch.*, ††var. minus, nov. var. (Pl. XIX. fig. 13.)

Var. dimidio minus diametro quam forma typica et striis paucioribus.

Long. 300 μ; lat. 12·5 μ; lat. ad apic. 7·5 μ.

I. Lough Derryclare.

8. C. prælongum, *Bréb.* (*Rabh. Fl. Europ. Alg.* iii. p. 130.)

I. Near Leenane.

††9. C. toxon, nov. sp. (Pl. XIX. fig. 14.)

Cl. circiter diametro 30plo longius, linearis, prope rectum, levissime concavum ad medium marginis superioris, leviter curvatum apices subtruncatos versus; massa chlorophyllacea in modo subspiralis non ordinata, laminis obscuris et cum pyrenoidibus minutis numerosis dispersis, locello distincto subapicali corpuscula 2–3 includente. Membrana achroa et non striata.

Long. 220–300 μ; lat. 8·5–10 μ.

I. Ballynahinch; Derryclare Lough.—II. Cromagloun.

10. CLOSTERIUM GRACILE, *Bréb. in Ralfs, Brit. Desm.* p. 221.

I. Near Westport; Roundstone; near Leenane; Kylemore; Ballynahinch; Lakes near Recess; Lough Shannacloontippen; Lough Aunierin; Shindilla and Arderry Loughs; near Oughterard; Athry Lough.—II. Adrigole; near Lough Brin; Torc Mt.; Cromagloun; Upper Lake of Killarney; Clogerheen; Glen Caragh; Sugar Loaf Mt.; Castletown; Carrantuohill.

††Forma GRACILLIMA. (Pl. XIX. fig. 15.)

Forma distincte attenuata, quam forma typica 1½plo longius.

Long. 440 μ; lat. 5 μ.

I. Arderry Lough.

A form of f. *gracillima* was observed from Kylemore, with obtuse ends: long. 375–410 μ; lat. 3·5–4 μ.

11. C. EHRENBERGII, *Menegh.* (*Ralfs, Brit. Desm.* p. 166, tab. 28. fig. 2.)

II. Carrantuohill.

12. C. MONILIFERUM, *Ehrenb.* (*Ralfs, l. c.* p. 166, tab. 28. fig. 3.)

Lat. 37–40 μ.

I. Near Westport.—II. Cromagloun; Kenmare; Upper Lake of Killarney.

13. C. JENNERI, *Ralfs.* (*Brit. Desm.* p. 167, tab. 28. fig. 6.)

Lat. 7–8 μ.

I. Near Westport; Creggan and Aunierin Loughs; near Leenane; Ballynahinch.—II. Loughs Guitane and Cloonee; Upper Lake of Killarney; Sugar Loaf Mt.; Glengarriff; Glen Caragh.

14. C. LEIBLEINII, *Kuetz.* (*Ralfs, Brit. Desm.* p. 167, tab. 28. fig. 4.)

Lat. 35–37 μ.

I. Near Westport; Creggan Lough.—II. Near Lough Brin.

Var. β, *Ralfs.* (*Brit. Desm.* p. 167.)

I. Ballynahinch.

15. C. DIANÆ, *Ehrenb.* (*Ralfs, l. c.* p. 168, tab. 28. fig. 5.)

Lat. 8·5–12·5 μ.

I. Near Westport: Moher, Shannacloontippen, and Athry Loughs; Kylemore; Roundstone; Ballynahinch; near Leenane; Lakes E. of Lough Bofin.—II. Loughs Guitane and Cloonee; Upper and Lower Lakes of Killarney; Glen Caragh; Carrantuohill; Sugar Loaf Mt.

16. Closterium pseudodianæ, *Roy.* (*Desm. Alford district, Scot. Naturalist*, Jan. 1890; *icon in lit.*)
II. Adrigole; Glen Caragh.

17. C. Venus, *Kuetz.* (*Ralfs, Brit. Desm.* p. 220, tab. 35. fig. 12.)
I. Near Oughterard; Lough Aunierin; Ballynahinch; Lakes near Recess; Creggan Lough.—II. Lower Lake of Killarney; Sugar Loaf Mt.; Kenmare; Glen Caragh; Glengarriff; Cloonee Lough.

18. C. incurvum, *Bréb.* [C. Leibleinii, *Kuetz.*, var. minus, *Rabh.* (*Fl. Europ. Alg.* p. 132).]
II. Carrantuohill.

19. C. Cynthia, *De Not.* (*Cooke, Brit. Desm.* p. 26, tab. 13. fig. 2.)
Lat. 15–17·5 μ.
I. Lakes, Clifden to Roundstone; near Westport.—II. Lough Guitane.

20. C. Archerianum, *Cleve, in Lund, Desm. Suec.* p. 77, tab. 5. fig. 13.
Lat. 22·5–30 μ.
I. Near Westport; Ballynahinch; Lakes, Clifden to Roundstone; Lough Shannacloontippen; Roundstone.—II. Lough Guitane; Cromagloun; Clogerheen; Sugar Loaf Mt.; Glen Caragh; Castletown; Cloonee Lough.

21. C. costatum, *Corda.* (*Alm. de Carlsbad*, 1835, tab. 5. figs. 61–63.)
Long. 365 μ; lat. 48 μ.
I. Near Oughterard; Lough Creggan; Lakes, Clifden to Roundstone; Lough Aunierin.—II. Cromagloun; Lough Guitane near Lough Brin; Glen Caragh; Castletown; Adrigole; Carrantuohill.

22. CLOSTERIUM STRIOLATUM, *Ehrenb.* (*Ralfs*, *Brit. Desm.* p. 170, tab. 29. fig. 2.)

I. Near Westport; near Leenane; Kylemore; Lakes, Clifden to Roundstone; Oorid Lough; Roundstone; near Oughterard; Creggan Lough; near Recess; Lough Shannacloontippen.—II. Cromagloun; Glen Caragh; Cloonee Lough; Sugar Loaf Mt.; Castletown.

Var. ORTHONOTUM, *Roy.* (*Fr. Wat. Alg. of Enbridge Lake and Vicinity*, *Journ. of Bot.* 1890, p. 336.)

Long. 300 μ; lat. 28 μ; lat. ad apic. 8–9 μ.

I. Lakes, Clifden to Roundstone.—II. Glen Caragh; near Lough Brin; Adrigole.

23. C. INTERMEDIUM, *Ralfs.* (*Brit. Desm.* p. 171, tab. 29. fig. 3.)

I. Lough Arderry; Kylemore; near Westport; Creggan Lough; Lough Aunierin.—II. Castletown; Carrantuohill.

24. C. ANGUSTATUM, *Kuetz.* (*Ralfs*, *l. c.* tab. 29. fig. 4.)

Long. 310–400 μ; lat. 16–22 μ; lat. ad apic. 12–13 μ.

I. Near Westport; Roundstone; Ballynahinch.—II. Castletown; Carrantuohill; Sugar Loaf Mt.

25. C. JUNCIDUM, *Ralfs.* (*Brit. Desm.* p. 172, tab. 29. fig. 6.)

I. Near Westport; near Leenane; Ballynahinch; Kylemore; Lough Aunierin.—II. Torc Mt.; Cromagloun; Sugar Loaf Mt.; Adrigole; Kenmare.

26. C. LINEATUM, *Ehrenb.* (*Ralfs*, *l. c.* p. 173, tab. 30. fig. 1.)

Long. 340 μ; lat. 13 μ.

I. Near Westport; near Leenane; Ballynahinch; near Oughterard; Kylemore; Roundstone.—II. Cromagloun; Lower Lake of Killarney; Glen Caragh; Castletown; Adrigole.

27. C. ATTENUATUM, *Ehrenb.* (*Ralfs*, *l. c.* p. 167, tab. 29. fig. 5.)

I. Kylemore; Lough Shannacloontippen; near Westport; Derryclare Lough; Ballynahinch.—II. Sugar Loaf Mt.; Glen Caragh.

28. C. RALFSII, *Bréb.*, var. HYBRIDUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 135.)

Long. 462 μ; lat. 31 μ.
I. Lough Aunierin.—II. Cromagloun.

29. CLOSTERIUM ROSTRATUM, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 175, tab. 30. fig. 3.)
I. Lough Aunierin; near Leenane.—II. Lower Lake of Killarney; Glen Caragh; Glengarriff.

30. C. SETACEUM, *Ehrenb.* (*Ralfs, l. c.* p. 176, tab. 30. fig. 4.)
I. Kylemore; Lough Aunierin; Ballynahinch; Roundstone. —II. Muckross; near Lough Brin; Adrigole.

31. C. KÜTZINGII, *Bréb.* (*Cooke, Brit. Desm.* p. 34, tab. 15. fig. 3.)
Long. 435–500 μ; lat. 15–20 μ; long. zygosp. 48 μ; lat. zygosp. 35 μ.
I. Baheh Loughs; Kylemore (cum zygosp.).

32. C. PRONUM, *Bréb.* (*Rabh. Fl. Europ. Alg.* iii. p. 136.)
I. Near Westport; near Leenane; near Oughterard; Ballynahinch; Clifden.

33. C. CORNU, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 176, tab. 30. fig. 6.)
I. Creggan Lough; near Westport.

Forma MAJOR, *Wille.* (*Ferskv. fra Nov. Seml.* p. 59, tab. 14. fig. 81.)
I. Kylemore.

34. C. ACUTUM, *Bréb. in Ralfs, Brit. Desm.* p. 177, tab. 30. fig. 5.
I. Creggan Lough.—II. Near Lough Brin; Lower Lake of Killarney; Adrigole.

35. C. SUBULATUM, *Bréb.* [C. acutum, *Bréb.*, var. β, *Ralfs.*]
Long. 177 μ; lat. 12·5 μ.
I. Lough Aunierin; near Oughterard.—II. Adrigole.

36. C. LINEA, *Perty.* [C. pronum, *Bréb.*; *d.* linea, *Klebs* (*Desm. Pruss.* p. 19, tab. 2. fig. 14).]
I. Ballynabinch; Oorid Lough.—II. Lower Lake of Killarney.

†37. Closterium subtile, *Bréb.*, forma. (Pl. XIX. fig. 16.)

A figure of a narrow form of this is given. Long. 91 μ; lat. 2 μ.

II. Cromagloun.

1. Penium margaritaceum, *Breb. in Ralfs, Brit. Desm.* p. 149, tab. 25. fig. 1.

I. Kylemore; Roundstone; Ballynahinch.—II. Carrantuohill.

Var. punctatum, *Ralfs.* (*Brit. Desm.* p. 149.)

I. Lough Shannacloontippen.—II. Lough Guitane.

2. P. cylindrus, *Bréb. in Ralfs, Brit. Desm.* p. 150, tab. 25. fig. 3.

I. Kylemore; Ballynahinch; Roundstone; Lough Shannacloontippen.

3. P. rufopellitum, *Roy.* (*Perthshire Desmids, Scot. Nat.* April 1877.)

Long. 40–45 μ; lat. 10–12·5 μ.

I. Kylemore.

†† 4. P. exiguum, nov. sp. (Pl. XIX. figs. 17, 18.)

P. parvum, cylindricum, 3–6plo longius quam latius, medio fere distincte constrictum (nonnunquam non constrictum), apicibus truncatis (nonnunquam amplioribus); membrana delicatissime granulata, granulis irregulariter dispositis, achroa; pyrenoidibus 2–3 in utroque semicellula in serie lineari ordinatis; locello subapicali corpuscula mobilia includente.

Long. 18·5–37 μ; lat. 6–8·5 μ.

I. Kylemore.—II. Cromagloun.

This species differs from *P. margaritaceum*, Bréb., and *P. cylindrus*, Bréb., in its smaller size, in the smaller granules which are not arranged in longitudinal lines, and in its colourless membrane. It also differs from *P. conspersum*, Wittr. (Om Gotlands och Ölands Sötvattens-Alger, p. 66) in its much smaller size, different form, &c.

5. P. spirostriolatum, *Bark.* (*Cooke, Brit. Desm.* p. 39; *Turner, in Journ. Roy. Micr. Soc.* 1885, p. 939, tab. 16. fig. 26.)

Long. 130–160 μ; lat. 17–20 μ.

I. Ballynahinch; Lough Aunierin; Lough Shannacloontippen; near Leenane; near Westport; Roundstone.—II. Lough Gui-

tane; Cloonee Lough; Cromagloun; Castletown; Glengarriff; Carrantuohill; 8 m. S. of Kenmare.

6. PENIUM DIGITUS, *Bréb. in Ralfs, Brit. Desm.* p. 150, tab. 25. fig. 3.

Long. 80–387 μ; lat. 20–82 μ; lat. ad apic. 18–40 μ.

I. Near Westport; Letereen Lough; Lough Creggan; near Oughterard; Lakes, Clifden to Roundstone; Ballynahinch; Roundstone; Derryclare Lough; Kylemore; Oorid Lough; Arderry Lough; Lough Shannacloontippen; Lough Shindilla; Lough Aunierin.—II. Lough Guitane; Cromagloun; Torc Mt.; Lower Lake of Killarney; Glen Caragh, near Lough Brin; Carrantuohill; Castletown; Glengarriff; Cloonee Lough; 8 m. S. of Kenmare.

††Var. CONSTRICTUM, nov. var.

P. diametro 6–8plo longius, apicibus truncatis, distincte sed late constrictum.

Long. 353–405 μ; lat. in centro 47–55 μ; lat. max. 55–65 μ.

I. Lakes, Clifden to Roundstone.

7. P. INTERRUPTUM, *Bréb. in Ralfs, Brit. Desm.* p. 151, tab. 25. fig. 4.

I. Lough Aunierin; Creggan Lough; near Westport.

††Var. SECTUM, nov. var.

Var. apicibus repente truncatis; membrana rufescente.

Long. 258 μ; lat. max. 47 μ; lat. ad apic. 20–22 μ.

I. Near Westport.

8. P. CLOSTERIOIDES, *Ralfs.* (*Brit. Desm.* p. 152, tab. 34. fig. 4.)

Long. 102–115 μ; lat. 20–22 μ; lat. apic. 9–11 μ.

I. Near Westport; near Leenane; Creggan Lough; Ballynahinch; Derryclare Lough; Lough Aunierin; near Oughterard; Kylemore.—II. Carrantuohill; Glen Caragh; Castletown; Adrigole.

9. P. NAVICULA, *Bréb.* (*Rabh. Fl. Alg. Europ.* iii, p. 121.)

Long. 32–41 μ; lat. 10–15 μ; lat. apic. 6–7 μ.

I. Lough Shannacloontippen; Ballynahinch; Roundstone; Lough Aunierin; Lakes east of Lough Bofin; Kylemore; Creggan Lough.—II. Lough Guitane; Muckross; Adrigole; Glen

Caragh; Lower Lake of Killarney; Cloonee Lough; Glengarriff; Carrantuohill.

10. PENIUM JENNERI, *Ralfs.* (*Brit. Desm.* p. 153, tab. 33. fig. 2.)

I. Lakes near Recess.

11. P. OBLONGUM, *De Bary.* (*Rabh. Fl. Europ. Alg.* iii. p. 119.)

II. Carrantuohill.

12. P. TRUNCATUM, *Ralfs.* (*Brit. Desm.* p. 152, tab. 25. fig. 5.)

Long. 42 μ; lat. 12·5 μ.

I. Near Oughterard; Moher Lough.—II. Carrantuohill; Glengarriff; Lower Lake of Killarney; Castletown.

Forma PUNCTATA, *West.* (*Additions Freshw. Alg. W. Yorks., in Naturalist*, Aug. 1891, p. 245.)

I. Clifden.

13. P. POLYMORPHUM, *Perty.* (*Lund, Desm. Suec.* p. 86, tab. 5. fig. 10.)

I. Clifden.—II. Carrantuohill; 8 m. S. of Kenmare.

†14. P. ADELOCHONDRUM, *Elfv.* (*Anteck. om Finska Desmidieer.*). (Pl. XIX. fig. 19.)

Long. 45 μ; lat. 16·5 μ.

II. Cromagloun.

15. P. MOOREANUM, *Arch.* (*Cooke, Brit. Desm.* p. 44.)

Long. 20 μ; lat. 7·5–8 μ; long. zygosp. 22·5 μ; lat. zygosp. 17·5 μ; crass. zygosp. 15 μ.

I. Near Oughterard.—II. Carrantuohill.

††16. P. SUBOCTANGULARE, nov. sp. (Pl. XXIV. fig. 20.)

P. minutum, circiter $1\frac{1}{2}$plo longius quam latius, oblongo-ellipticum, apicibus late rotundatis, membrana glabra et achroa; zygosporæ quadratæ oblongæve angulis truncatis subretusisque, e vertice et e latere visæ ellipticæ, membrana crassa et rufescente.

Long. 14–16 μ; lat. 10 μ; long. zygosp. 25–28 μ; lat. zygosp. 20–25 μ; crass. zygosp. 18 μ.

II. Lower Lake of Killarney.

17. P. CUCURBITINUM, *Biss.* (*Journ. Roy. Micr. Soc.* 1884, p. 197, tab. 5. fig. 7.)

I. Lakes near Recess; Ballynahinch.—II. Castletown: Carrantuohill.

†18. Penium Clevei, *Lund.* (*Desm. Suec.* p. 86, tab. 5. fig. 11.)
Long. 106 μ; lat. 45 μ; lat. isthm. 42 μ.
I. Roundstone; Ballynahinch.

19. P. minutum, *Cleve.* [Docidium minutum, *Ralfs*; Penium minutum, *d.* genuinum, *Racib.* (*Nonnul. Desm. Polon.* p. 5, tab. 5. fig. 11).]

Forma genuina.
Long. 97–168 μ; lat. ad bas. semicell. 12·5–14 μ; lat. ad apic. 8·5–11 μ.
I. Near Westport; Ballynahinch; Kylemore; Roundstone; Glendalough; near Oughterard; Loughs Aunierin and Shindilla; Lakes near Recess; near Leenane; Nacoogarrow Lough. —II. Cromagloun; Torc Mt.; Carrantuohill; Glen Caragh; Sugar Loaf Mt.; Adrigole; Glengarriff.

Forma major, *Lund.* (*Desm. Suec.* p. 87.) [P. minut. *c.* major, *Lund* (*Racib. l. c*).]
Long. 202–210 μ; lat. prope bas. semicell. 12·5 μ; lat. prope apic. 9 μ.
I. Ballynahinch.

†Forma minor, *Racib.* [P. minut. *b.* minor, *Racib.* (*l. c.*).]
Long. 73 μ; lat. prope bas. semicell. 11·5 μ; lat. prope apic. 9 μ.
II. Cromagloun.
The form noticed was not exactly cylindrical as in Raciborski's description, but somewhat tapering.

Var. gracile, *Wille.* (*Bg. till Kunds. om Norges Ferskv.* p. 51, tab. 2. fig. 33.) [P. minut. *a.* gracile, *Wille* (*Racib. l. c.*).]
Long. 130–160 μ; lat. prope bas. semicell. 10·5–12 μ; lat. prope apic. 10 μ.
I. Near Oughterard; Ballynahinch.—II. Cromagloun.

†Var. tumidum, *Wille* (*l. c.* f. 34). [P. minut. *f.* tumidum, *Wille* (*Racib. l. c.*).]
Long. 90–102 μ; lat. max. 17·5–20 μ; lat. isthm. 13–15 μ; lat. prope apic. 11–12·5 μ.
I. Ballynahinch.

†Var. ALPINUM, *Racib.* [P. minut. *e.* alpinum, *Racib.* (*Nonnul. Desm. Polon.* p. 5).]

Long. 125–170 μ; lat. prope bas. semicell. 12·5–14 μ; lat. prope apic. 8–10 μ.

I. Oorid Lough.—II. Cromagloun.

†Var. POLONICUM, *nob.* [P. (Docidium ?) polonicum, *Racib.* (*l. c.* f. 12).]

Long. 145–165 μ; lat. prope bas. semicell. 12·5–15 μ; lat. isthm. 10–11 μ; lat. prope apic. 5–6 μ.

II. Cromagloun.

The Irish forms of the last four varieties are all of somewhat larger dimensions than the originals. After examining a very large number of examples from near Cromagloun, I do not consider that *P. polonicum*, Racib., is a distinct species, as forms were noticed connecting it with var. *alpinum*, Racib.

††Var. CRASSUM, nov. var. (Pl. XX. fig. 1.)

Var. diametro 4½plo longius, apices versus attenuata, lateribus subrectis, constrictione distincta sed levi.

Long. 71–85 μ; lat. prope bas. semicell. 16–18 μ; lat. isthm. 13–14 μ; lat. prope apic. 12·5 μ.

I. Ballynahinch; Nacoogarrow Lough.—II. Adrigole; Carrantuohill.

††Var. CRASSUM, nov. var., f. PUNCTATA. (Pl. XX. fig. 2.)

Membrana distincte punctata.

Long. 77 μ; lat. prope bas. semicell. 18 μ; lat. ad apic. 13 μ.

I. Ballynahinch.

††Var. CRASSUM, nov. var., f. INFLATA. (Pl. XX. fig. 3.)

F. diametro 3¼–4plo longius; semicellulis distincte inflatis.

Long. 65–80 μ; lat. prope bas. semicell. 20–21 μ; lat. prope apic. 13·5–15 μ.

This totally differs from var. *tumidum*, Wille, in its relatively greater thickness.

I. Ballynahinch.

††Var. UNDULATUM, nov. var. (Pl. XX. fig. 4.)

Var. semicellulis regulariter sed leve 5-undulatis utrobique.

Long. 101 μ; lat. prope bas. semicell. 12·5 μ; lat. prope apic. 9 μ.

II. Cromagloun.

1. CYLINDROCYSTIS BRÉBISSONII, *Menegh.* [Penium Brebissonii, *Ralfs*, *Desm.* p. 153, tab. 25. fig. 6.]

I. Moher Lough; Ballynahinch; Lough Shannacloontippen.—II. Lough Guitane; Upper Lake of Killarney; Carrantuohill; Sugar Loaf Mt.

2. C. DIPLOSPORA, *Lund.* (*Desm. Suec.* p. 83, tab. 5. fig. 7.)

I. Arderry Lough; Ballynahinch; Lough Shannacloontippen; Nacoogarrow Lough.—II. Cromagloun.

††* MAJOR, nov. subsp. (Pl. XX. fig. 5.)

C. permagna, diametro duplo longior, medio non constricta sed subplana, utroque polo rotundata; a vertice visa circularis; membrana achroa, glabra.

Long. 102 μ; lat. 48 μ.

I. Lakes, Clifden to Roundstone.

3. C. CRASSA, *De Bary.* [Penium rupestre, *Rabh. Fl. Europ. Alg.* iii. p. 120.]

Long. 22–29 μ; lat. 18–20 μ.

I. Kylemore; Ballynahinch.—II. Carrantuohill; near Lough Brin.

†1. MESOTÆNIUM MICROCOCCUM, *Kirchn.* [Palmoglœa micrococca, *Kuetz.*]

Long. 12–15 μ; lat. 6·5–8·5 μ.

I. Lakes, Clifden to Roundstone.—II. 8 m. S. of Kenmare.

2. M. CHLAMYDOSPORUM, *De Bary.* (*Cooke, Brit. Desm.* p. 47, tab. 18. fig. 4.) (Pl. XXIV. fig. 8.)

Long. 16–21 μ; lat. 8·5–10 μ; diam. matur. zygosp. 16–25 μ.

I. Near Westport.

3. M. DE-GREYII, *W. Turn.* (*Naturalist*, 1886, p. 34, tab. 1. fig. 1.)

II. Castletown.

††Var. BREVE, nov. var. (Pl. XX. fig. 6.)

Hæc varietas multum brevior est quam forma typica.

Long. 58 μ; lat. 21–22 μ.

II. On dripping rocks with *Amphoridium Mougeotii* and other mosses, Torc Mt.

1. TETMEMORUS BRÉBISSONII, *Ralfs.* (*Brit. Desm.* p. 145, tab. 24. fig. 1.)

Long. 155–162 μ; lat. 30–33 μ; lat. isthm. 22–25 μ.

I. Near Westport; Aunierin, Shindilla, Creggan, and Shannacloontippen Loughs; Lakes near Recess; near Oughterard; Ballynahinch; Roundstone; Clifden.—II. Cromagloun; Carrantuohill; Sugar Loaf Mt.; Glengarriff; Lower Lake of Killarney; Castletown; Adrigole.

Var. MINOR, *De Bary.*

Long. 57 μ; lat. 15 μ; lat. isthm. 11 μ.

I. Near Oughterard; Lakes near Recess; Clifden.—II. Near Lough Brin.

2. TETMEMORUS GRANULATUS, *Ralfs.* (*Brit. Desm.* p. 146, tab. 24. fig. 3.)

Long. 138–238 μ; lat. 30–45 μ; lat. isthm. 25–40 μ.

I. Near Westport; Ballynahinch (cum zygosp.); Roundstone; Athry, Creggan, Arderry, Aunierin, Oorid, Shannacloontippen, Shindilla, and Derryclare Loughs; Lakes E. of Lough Bofin; Kylemore; near Oughterard.—II. Torc Mt.; Cromagloun; Carrantuohill; Loughs Cloonee and Guitane; Adrigole; Glengarriff; Upper and Lower Lakes of Killarney; Glen Caragh; Castletown; near Lough Brin; Sugar Loaf Mt.; Clogerheen; 8 m. S. of Kenmare.

†Forma MINOR, *Nord.* (*Alg. Sandvic.* p. 10).

Long. 95–100 μ; lat. 21–23·5 μ.

I. Ballynahinch.

††Var. ATTENUATUS, nov. var. (Pl. XX. fig. 7.)

Var. apicibus attenuatis et subconstrictis.

Long. 170–182 μ; lat. ad bas. semicell. 30 μ; lat. isthm. 22–25 μ; lat. ad apic. 15–17 μ; lat. sub apic. 15 μ.

I. Lough Aunierin; near Oughterard; Ballynahinch; Lakes, Clifden to Roundstone.—II. Lough Guitane; Castletown; Lower Lake of Killarney; Torc Mt.

3. T. LÆVIS, *Ralfs.* (*Brit. Desm.* p. 147, tab. 24. fig. 2.)

I. Ballynahinch; Kylemore; near Oughterard; Lakes east of Lough Bofin; Clifden.—II. Cromagloun; Carrantuohill; Adrigole; near Lough Brin; Glen Caragh; Lower Lake of Killarney.

1. SPIROTÆNIA CONDENSATA, *Bréb. in Ralfs, Brit. Desm.* p. 179, tab. 34. fig. 1.

Long. 270 μ; lat. 27 μ.

I. Lakes, Clifden to Roundstone; near Leenane; near Oughterard.—II. Lough Guitane; Glengarriff; Lower Lake of Killarney; Cloonee Lough; Castletown.

††2. S. BISPIRALIS, nov. sp. (Pl. XX. fig. 8.)

Sp. fusiformis, in gelatina matricale nidulans, diametro 5plo longior, apicibus subtruncatis, massa chlorophyllacea in fasciis spiralibus gracilibus duobus, anfractibus densis circiter novem.

Long. 86–100 μ; lat. max. 18–20 μ; lat. apic. 4–6 μ.

I. Near Westport.

This species differs from *S. condensata*, Bréb., in having *two slender* spirals and in its subtruncate ends. It is distinguished from *S. obscura,* Ralfs, in the definite number of spirals and in the widely different number of revolutions.

3. S. OBSCURA, *Ralfs*. (*Brit. Desm.* p. 179, tab. 34. fig. 2.)

II. Near Lough Brin.

1. MICRASTERIAS MUCRONATA, *Rabh.* (*Fl. Europ. Alg.* iii. p. 187.)

I. Kylemore.

2. M. PINNATIFIDA, *Ralfs*. (*Brit. Desm.* p. 77, tab. 10. fig. 3.)

Long. 53–61 μ; lat. 57–65 μ; lat. isthm. 12·5–17 μ.

I. Ballynahinch; Lough Aunierin; Creggan Lough; Athry Lough; Moher Lough.—II. Adrigole.

A form of this from Ballynahinch was occasionally met with which had the basal lobes of each semicell distinctly and regularly tridentate. (Pl. XX. fig. 9.)

3. M. FURCATA, *Ag.* (*Ralfs, Brit. Desm.* p. 73, tab. 9. fig. 2.)

Long. 160–170 μ; lat. 145–187 μ; lat. isthm. 20–25 μ.

I. Derryclare Lough; Lakes, Clifden to Roundstone; Glendalough.

4. M. CRUX-MELITENSIS, *Ralfs*. (*Brit. Desm.* p. 73, tab. 9. fig. 3.)

Long. 117–120 μ; lat. 107–110 μ; lat. isthm. 19 μ.

I. Creggan Lough; Ballynahinch; Lakes near Recess.

5. Micrasterias americana, *Ralfs in Brit. Desm.* p. xix (errata et addenda), tab. 10. fig. 1.

II. Carrantuohill.

6. M. denticulata, *Bréb.* (*Ralfs, Brit. Desm.* p. 70, tab. 7. fig. 1.)

Long. 205–235 μ; lat. 185–192 μ; lat. isthm. 31–40 μ.

I. Near Leenane; near Westport; Derryclare Lough; Creggan Lough; Nacoogarrow Lough; Ballynahinch; Lough Aunierin; Kylemore; near Oughterard; Roundstone; near Recess.—II. Carrantuohill; Glengarriff; Castletown.

7. M. rotata, *Ralfs.* (*Brit. Desm.* p. 71, tab. 8. fig. 1.)

Long. 220–240 μ; lat. 195–220 μ; lat. isthm. 35–40 μ.

I. Near Westport; near Oughterard; Lakes, Clifden to Roundstone; Nacoogarrow Lough; Ballynahinch; Kylemore; Creggan Lough; Lough Aunierin.—II. Cromagloun; Torc Mt.; Sugar Loaf Mt.; Glen Caragh; Glengarriff; Castletown; Clogerheen.

††Forma granulata.

F. membrana irregulariter sparsimque sed distinctissime granulata.

I. Lough Aunierin.

8. M. Thomasiana, *Arch.* (*Rabh. Alg. Europ.* 1868, p. 192.)

II. Glen Caragh; Cloonee Lough.

††Forma major.

Long. 315 μ; lat. 285 μ; lat. isthm. 38 μ.

I. Arderry Lough.

The specimens observed only differed from the type in being about half as large again.

The following dimensions show the relative breadth and length of specimens observed from various parts of the British Isles:—

Arderry Lough, Connemara......	lat. : long.	=1 : 1·105.
Glen Shee, Perthshire	„	=1 : 1·266.
Wrynose, Lake District	„	=1 : 1·200.
Mr. W. Archer's original specimens from Ireland	„	=1 : 1·129.

9. M. radiosa, *Ag.* (*Ralfs, Brit. Desm.* p. 72, tab. 8. fig. 3.)

Long. 150 μ; lat. 130 μ; lat. isthm. 30 μ.

I. Derryclare Lough.

10. Micrasterias papillifera, *Bréb. in Ralfs, Brit. Desm.* p. 72, tab. 9. fig. 1.

Long. 135–145 μ; lat. 115–145 μ; lat. isthm. 15 μ.

I. Ballynahinch; near Westport; Creggan Lough; Derryclare and Moher Loughs.—II. Glengarriff; Cloonee Lough; Castletown; Adrigole.

†Var. glabra, *Nord. in Nord. et Wittr. Alg. Exsic.* no. 466.

I. Ballynahinch.

†Var. glabra, *Nord.*, ††forma inflata. (Pl. XX. fig. 10.)

Forma semicellulis inflatione ad basin instructis.

Long. 84 μ; lat.=long.; lat. isthm. 15 μ; crass. 29 μ.

I. Ballynahinch.

11. M. truncata, *Bréb. in Ralfs, Brit. Desm.* p. 75, tab. 8. fig. 4, tab. 10. fig. 5.

Long. 100–110 μ; lat. 90–108 μ; lat. isthm. 20–27 μ.

I. Near Westport; Ballynahinch; Kylemore; Creggan, Shindilla, Arderry, Oorid, and Derryclare Loughs; Roundstone; near Oughterard; Lough Aunierin; near Recess.—II. Cromagloun Muckross; Carrantuohill; Glen Caragh; Castletown; near Lough Brin; Glengarriff.

†Forma granulata, *Racib.* (*Desm. Nov.* 1889, p. 26.)

I. Ballynahinch; Athry Lough.

††Forma punctata.

Forma membrana insigniter punctata.

Long. 50 μ; lat.=long.; lat. isthm. 30 μ.

I. Near Oughterard; Nacoogarrow Lough.—II. Lough Guitane.

12. M. crenata, *Bréb. in Ralfs, Brit. Desm.* p. 75, tab. 7. fig. 2, tab. 10. fig. 4.

I. Kylemore; Lakes, Clifden to Roundstone.

13. M. Jenneri, *Ralfs.* (*Brit. Desm.* p. 76, tab. 11. fig. 1.)

Long. 162–165 μ; lat. 105–117 μ; lat. isthm. 33 μ.

I. Kylemore.—II. Carrantuohill.

Var. simplex, *West.* (*Fr. Wat. Alg. of N. Wales, in Journ. R. Micr. Soc.* April 1890, p. 287, pl. vi. fig. 34.) [M.

Jenneri, *Ralfs*, f. Brasiliensis, *Boerg.* (*Desm. Brasil.* p. 936, tab. 2. fig. 11).]

Long. 150 μ; lat. 100 μ; lat. isthm. 25 μ.

I. Ballynahinch.

1. EUASTRUM VERRUCOSUM, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 79, tab. 11. fig. 2.)

Long. 93–110 μ; lat. 75–86 μ; lat. isthm. 22 μ.

I. Creggan, Boy, Shannacloontippen, and Derryclare Loughs; Lough Aunierin; Lakes, Clifden to Roundstone, and near Recess; near Westport; Lakes E. of Lough Bofin.—II. Lough Guitane; Glengarriff; Cloonee Lough; Muckross; Adrigole.

†Var. COARCTATUM, *Delp.*, forma. (Pl. XX. fig. 11.)

A form of this is figured which has the intermediate lobules of the semicells very short, with the subapical sinus wider and shallower.

Long. 90 μ; lat. ad bas. semicell. 76 μ; lat. pol. lob. 32·5 μ; lat. isthm. 21 μ.

I. Derryclare Lough.

Compare with *E. verrucosum*, Ehrnb., *reductum*, Nord. (De Alg. et Char. i. p. 9, tab. 16. fig. 14).

†Var. ALATUM, *Wolle.* (*Desm. U.S.* p. 101, tab. 26. fig. 4.)

II. Cloonee Lough.

2. E. OBLONGUM, *Ralfs.* (*Brit. Desm.* p. 80. tab. 12.)

Long. 144–167 μ; lat. 80–83 μ; lat. isthm. 20–26 μ; crass. 52 μ.

I. Near Westport; Lakes, Clifden to Roundstone, and E. of Lough Bofin; near Oughterard; Ballynahinch; Derryclare Lough.—II. Lough Guitane; Cromagloun; Torc Mt.; Muckross; Glengarriff; Castletown; Carrantuohill; Glen Caragh.

3. E. CRASSUM, *Kuetz.* (*Ralfs, Brit. Desm.* p. 81, tab. 11. fig. 3.)

Long. 167–185 μ; lat. 87–97 μ; lat. isthm. 24–27 μ.

I. Ballynahinch; Kylemore; Lough Aunierin; Oorid Lough; Arderry Lough; near Oughterard.—II. Cromagloun; Torc Mt.; Muckross; Carrantuohill; Glen Caragh; Sugar Loaf Mt.; Glengarriff; Upper Lake of Killarney; Castletown.

†Var. SCROBICULATUM, *Lund.* (*Desm. Suec.* p. 18, tab. 2. fig. 1.)

II. Cromagloun.

4. Euastrum pinnatum, *Ralfs.* (*Brit. Desm.* p. 81, tab. 13. fig. 1.)

Long. 132–144 μ; lat. 70–77 μ; lat. isthm. 22–24 μ; crass. 47–50 μ.

I. Roundstone; Ballynahinch; Lough Aunierin; Lough Shindilla.—II. Castletown; Carrantuohill.

5. E. humerosum, *Ralfs.* (*Brit. Desm.* p. 82, tab. 13. fig. 2.)

II. Lough Guitane; Carrantuohill.

6. E. ventricosum, *Lund.* (*Desm. Suec.* p. 18, tab. 2. fig. 2.)

Long. 115 μ; lat. 63 μ; lat. isthm. 28 μ; crass. 33 μ.

I. Ballynahinch; Kylemore; Lakes near Recess.—II. Carrantuohill.

7. E. affine, *Ralfs.* (*Brit. Desm.* p. 82, tab. 13. fig. 3.)

I. Near Westport; near Oughterard; Lough Aunierin; Ballynahinch.—II. Castletown.

8. E. ampullaceum, *Ralfs.* (*Brit. Desm.* p. 83, tab. 13. fig. 4.)

Long. 110 μ; lat. 58 μ; lat. isthm. 17·5 μ.

I. Kylemore; near Oughterard; Roundstone; Oorid Lough; Lakes, Clifden to Roundstone.—II. Cromagloun; Torc Mt.; Glen Caragh; Carrantuohill; Castletown; 8 m. S. of Kenmare.

9. E. insigne, *Hass.* (*Ralfs, l. c.* p. 83, tab. 13. fig. 6.)

II. Cromagloun; Glen Caragh; Torc Mt.

10. E. didelta, *Ralfs.* (*Brit. Desm.* p. 84, tab. 14. fig. 1.)

Long. 130–195 μ; lat. 70–75 μ; lat. isthm. 16 μ; crass. 42–45 μ.

I. Near Westport; near Oughterard; Loughs Aunierin, Nacoogarrow, Shindilla, and Shannacloontippen; Ballynahinch.—II. Cromagloun; Lough Guitane; Torc Mt.; Upper Lake of Killarney; Carrantuohill; Adrigole; Glengarriff; Glen Caragh; Castletown.

11. E. cuneatum, *Jenner, in Ralfs, Brit. Desm.* p. 90, tab. 32. fig. 3.

Long. 125 μ; lat. 58 μ; lat. isthm. 22 μ.

I. Near Oughterard.—II. Carrantuohill.

12. Euastrum ansatum, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 85, tab. 14. fig. 2.)

Long. 72–86 μ; lat. 32–42 μ; lat. isthm. 12–15 μ.

I. Athry, Derryclare, Aunierin, and Shannacloontippen Loughs; Lakes, Clifden to Roundstone; near Oughterard; Clifden; Ballynahinch; near Westport; Kylemore.— II. Clogerheen; Cromagloun; Lough Guitane; Glen Caragh; Castletown; Sugar Loaf Mt.; Glengarriff; Upper and Lower Lakes of Killarney; near Lough Brin; 8 m. S. of Kenmare.

13. E. circulare, *Hass.* (*Ralfs, l. c.* p. 85, tab. 13. fig. 5.)

I. Nacoogarrow Lough.—II. Lough Guitane; Upper Lake of Killarney; Carrantuohill.

14. E. sinuosum, *Lenorm.* (*Ralfs, Brit. Desm.* p. 85.)

Long. 56–57 μ; lat. 35 μ; lat. isthm. 9–10 μ; crass. 21 μ.

I. Ballynahinch; Lough Shannacloontippen.—II. 8 m. S. of Kenmare.

15. E. pectinatum, *Bréb. in Ralfs, Brit. Desm.* p. 86, tab. 14. fig. 5. (Pl. XXIV. fig. 7).

Long. 55–62 μ; lat. 33–35 μ; lat. isthm. 10–12·5 μ; crass. 21–23 μ; long. zyg. cum spin. 57 μ; long. zyg. sine spin. 50 μ; lat. zyg. cum spin. 46 μ; lat. zyg. sine spin. 35 μ.

I. Arderry, Athry, Baheh, Shindilla, Creggan, Derryclare, Aunierin, Shannacloontippen, Boy and Nacoogarrow Loughs; Ballynahinch (cum zygosp.); Glendalough; Kylemore; Lakes, Clifden to Roundstone; near Westport; Roundstone; Lakes E. of Lough Bofin.—II. Upper and Lower Lakes of Killarney; near Lough Brin; Sugar Loaf Mt.; Glengarriff; Torc Mt.; Castletown; Cromagloun; Lough Guitane; 8 m. S. of Kenmare.

16. E. gemmatum, *Bréb.* (*Ralfs, Brit. Desm.* p. 87, tab. 14. fig. 4.)

Long. 52–70 μ; lat. 38–47 μ; lat. isthm. 12–13 μ; crass. 30 μ.

I. Ballynahinch; Creggan Lough; Aunierin and Moher Loughs; near Westport.—II. Glengarriff; Castletown.

17. E. rostratum, *Ralfs.* (*Brit. Desm.* p. 88, tab. 14. fig. 6.)

Long. 32–34 μ; lat. 23–25 μ; lat. isthm. 6–7·5 μ.

I. Derryclare, Moher, and Shannacloontippen Loughs; Roundstone; near Westport.—II. Sugar Loaf Mt.

18. Euastrum elegans, *Kuetz.* (*Ralfs, Brit. Desm.* p. 89, tab. 14. fig. 7.) Forma, Pl. XX. fig. 12.

I. Arderry, Nacoogarrow, Letereen, Athry, Boy, Creggan, Derryclare, Aunierin, Shannacloontippen, and Moher Loughs; Ballynahinch; Clifden; Glendalough; near Oughterard; near Recess; Roundstone; near Westport; Lakes E. of Lough Bofin.—II. Loughs Guitane and Cloonee; Cromagloun; Muckross; Torc Mt.; Carrantuohill; near Lough Brin; Adrigole; Castletown; Upper and Lower Lakes of Killarney.

Var. bidentata, *Naeg.* [? E. elegans, *Kuetz.*, β. speciosum, *Boldt.* (*Desm. Grönl.* p. 7, tab. 1. figs. 10 & 11).]

I. Creggan Lough; Lakes E. of Lough Bofin; near Oughterard.

†19. E. pictum, *Boerg.* (*Desm. Brasil.* p. 939, tab. 3. fig. 19.)

I. Oorid Lough; Arderry Lough; Lakes near Recess.—II. Glen Caragh; Lough Guitane; Castletown; Carrantuohill.

20. E. inerme, *Lund.* (*Desm. Suec.* p. 20, tab. 2. fig. 3.)

Long. 50–60 μ; lat. 30–32·5 μ; lat. isthm. 7·5–8 μ; crass. 20 μ.

I. Athry, Aunierin and Derryclare Loughs; Ballynahinch.—II. Castletown; Glengarriff.

††21. E. pyramidatum, nov. sp. (Pl. XX. fig. 13.)

E. parvum, diametro subduplo longius, profunde constrictum, sinu lineari extremo ampliato, semicellulæ pyramido-truncatæ, lateribus concavis apicem versus, undulis duabus levissimis prope basin, subemarginatæ apice; a vertice visæ rhomboideæ, angulis rotundatis et lateribus convexis; a latere visæ trigono-pyramidatæ, lateribus concavis; membrana lævis; pyrenoidibus singulis.

Long. 25–27 μ; lat. ad bas. semicell. 16–18 μ; lat. ad apic. 9–10 μ; lat. isthm. 3·5–4 μ; crass. 12·5 μ.

I. Ballynahinch; Kylemore; Roundstone.

Compare with *Cosmarium sublobatum* (Bréb.), Arch.

22. E. binale, *Ralfs.* (*Brit. Desm.* p. 90, tab. 14. fig. 8.)

I. Ballynahinch; Creggan Lough; Kylemore; near Recess; Lough Shindilla; Lough Aunierin; Lough Shannacloontippen; near Oughterard; near Westport.—II. Lough Guitane; Upper

Lake of Killarney; Carrantuohill; Lower Lake of Killarney; Adrigole; Glen Caragh; Glengarriff.

Forma MINOR, *West.* (*Desm. Maine, in Journal of Bot.* Nov. 1888.)

I. Lakes, Clifden to Roundstone; Ballynahinch; Roundstone; Athry Lough.

††Forma HIANS. (Pl. XX. fig. 14.)

Forma sinu lato rectangulareque repente angusto extremo leviter ampliato.

Long. 11 μ; lat. 10–11 μ; lat. isthm. 2·5–3 μ; crass. 6 μ.

I. Ballynahinch; Lakes near Recess.

Var. ELOBATUM, *Lund.* (*Desm. Suec.* p. 23, tab. 2. fig. 7.)

I. Ballynahinch; Derryclare Lough.

Var. INSULARE, *Wittr.* (*Om Gotl. och Ol. Sötv.* p. 49, tab. 4. fig. 7.)

II. Lower Lake of Killarney.

††*SUBELOBATUM, nov. subsp. (Pl. XX. fig. 15.)

E. parvum, diametro 1½plo longius, profunde constrictum, sinu lineari extremo ampliato; semicellulæ trapezoideæ, angulis inferioribus rectangularibus biundulatis, lateribus superioribus convergentibus uniundulatis, late emarginatæ apice; a vertice visæ undulato-rhomboideæ; a latere visæ subrotundæ, papilla mediana apice lateribusque; membrana glabra.

Long. 26 μ; lat. 18 μ; lat. isthm. 5 μ; crass. 12·5 μ.

I. Lough Aunierin.—II. Lough Guitane.

†23. EUASTRUM CRASSANGULATUM, *Boerg.* (*Desm. Brasil.* p. 942, tab. 3. fig. 25.)

††Var. ORNATUM, nov. var. (Pl. XX. fig. 16.)

Semicellulæ granulis sex medio (quinque annulo circa granulum centralem) et granulis sex intra ambitum.

Long. 27 μ; lat. 17·5 μ; lat. isthm. 4·5 μ; crass. 14 μ.

I. Ballynahinch.

24. E. DENTICULATUM, *Gay.* (*Sur les Conj. du Midi de la France*, 1884, p. 335.)

Long. 17–21·5 μ; lat. 15–20 μ; lat. isthm. 4–6·5 μ; crass. 14 μ.

I. Creggan Lough; near Recess; near Westport; Moher, Boy, Aunierin, Shannacloontippen, and Shindilla Loughs; Glen-

dalough; Ballynahinch; Athry Lough; Lakes, Clifden to Roundstone, and E. of Lough Bofin.—II. Muckross; Lough Guitane; Adrigole; Carrantuohill; Upper Lake of Killarney; near Lough Brin; Glen Caragh; Cloonee Lough; Glengarriff.

††Var. GRANULATUM, nov. var. (Pl. XX. fig. 17.)

Semicellulæ granulis tribus (nec quinque) medio basin versus; membrana granulatiore; angulis superioribus sine dentibus acutis.

Long. 18 μ; lat. 18 μ; lat. isthm. 4 μ; crass. 9 μ.

I. Ballynahinch.

††25. EUASTRUM TURNERII, nov. sp. (Pl. XX. fig. 18.)

E. subparvum, diametro 1½plo longius, profunde constrictum, sinu lineari extremo ampliato; semicellulæ trapezoideæ quinquelobæ, lobo polari undulis parvis quatuor, anguste inciso, spino divergente ad angulos papilla, infra spinam, lobis lateralibus truncato-emarginatis; membrana granulata glabra medium versus, projectione mediana granulata ad apicem; a vertice visæ ellipticæ (projectione mediana conspecta); a latere visæ triangulato-ovatæ apiculatæ.

Long. 50 μ; lat. ad bas. semicell. 33 μ; lat. poll. lob. 23 μ; lat. isthm. 9 μ; crass. 20 μ.

I. Derryclare Lough.

E. sp. "ad *E. denticulatum*, Gay, accedens," Nordst. (Fr. Wat. Alg. of New Zeal. and Austr. p. 35, pl. 3. fig. 11), is evidently a form of this species.

Compare with *E. abruptum*, Nord. (Desm. Brasil. tab. 2. fig. 3), *β. evolutum*, Nord. (Nonnullæ Algæ Brasil. p. 21, tab. 2. fig. 7).

Named in honour of my able friend Mr. W. B. Turner, F.R.M.S., &c.

††26. E. SCITUM, nov. sp. (Pl. XXIV. fig. 13.)

E. submediocre, tertia parte longius quam latius, ambitu profunde crenatum, truncato-ellipticum, profunde constrictum, sinu lineari angusto extremo ampliato; semicellulæ semicirculares, margine laterali unoquoque 4-crenata (duobus in medio parvioribus), crenis granulatis, apice late inciso; a vertice visæ ellipticæ, inflatione mediana truncata; a latere visæ quadrato-oblongæ, inflatione truncata ad basin.

Long. 42 μ; lat. 31 μ; lat. isthm. 8·5 μ; crass. 18 μ.

II. Carrantuohill.

Compare with *Cosmarium nasutum*, Nord. (Desm. Spetsb. p. 33, tab. 7. fig. 17).

1. COSMARIUM QUADRATUM, *Ralfs*. (*Brit. Desm.* p. 92, tab. 15. fig. 1.)

Long. 50–52 μ; lat. 30 μ; lat. isthm. 12–13 μ.

I. Near Westport; Lakes, Clifden to Roundstone; Lough Aunierin.—II. Carrantuohill.

2. C. PLICATUM, *Reinsch*, ††var. HIBERNICUM, nov. var. (Pl. XXIV. fig. 9.)

Var. leviter constricta infra, apicibus convexis, membrana punctata.

Long. 90 μ; lat. 47 μ; lat. isthm. 18 μ.

II. Carrantuohill.

3. C. SINUOSUM, *Lund*, †var. DECEDENS, *Reinsch*. (*Nord. Desm. Arct.* tab. 8. fig. 41.)

II. Carrantuohill.

†4. C. TATRICUM, *Racib*. (*De nonnul. Desm. Polon.* p. 22. tab. 1. fig. 12.)

††Var. SPHÆRULIFERUM, nov. var. (Pl. XX. fig. 11.)

Var. major quam forma typica; semicellulæ granulis 10 levibus (sed distinctis), cum 7 intra ambitum regulariter dispositis, tribus reliquis prope isthmum; cellulæ a latere conspectæ distincte constrictæ.

Long. 45 μ; lat. ad bas. semicell. 25 μ; lat. ad apic. 18·5 μ; lat. isthm. 15 μ; crass. 14 μ.

I. Lough Shannacloontippen.

In having the lateral view constricted it agrees with the var. *novizelandicum*, Nord. (Fr. Wat. Alg. of New Zeal. and Austr. p. 56, tab. 6. fig. 6), which is also larger than the type.

5. C. NYMANNIANUM, *Grun. in Rabh. Fl. Europ. Alg.* iii. p. 166.

I. Oorid Lough.—II. Glen Caragh; Castletown; Lower Lake of Killarney.

6. C. HAMMERI, *Reinsch*. (C. homalodermum, *Nord.*)

Long. 50 μ; lat. 35 μ; lat. isthm. 13 μ.

I. Creggan Lough; Derryclare Lough; Clifden; Lakes, Clifden to Roundstone; Lough Aunierin; Nacoogarrow Lough; Boy Lough.

†7. Cosmarium eductum, *Roy et Biss. in Nord. Desmideer från Bornholm*, p. 198, tab. 6. fig. 8.

††Var. angustatum, nov. var. (Pl. XX. fig. 20.)

Var. minor, apicibus angustioribus, constrictione profundiore; membrana delicatissima sed distincte punctata.

Long. 30 μ; long. partis productæ 3·5–4 μ; lat. max. 21·5 μ; lat. sub apic. 14 μ; lat. apic. 11–12·5 μ; lat. isthm. 6·5.

I. Ballynahinch.

The faintly undulate lateral margins of this Irish form are intermediate between the figs. 8 *a* and 8 *b* (Nordst. *l. c.*).

8. C. Holmiense, *Lund.* (*Desm. Suec.* p. 49, tab. 2. fig. 20.)

I. Near Oughterard.—II. Glen Caragh.

9. C. anceps, *Lund.* (*Desm. Suec.* p. 48, tab. 3. fig. 4.)

I. Ballynahinch; Lough Aunierin.

10. C. granatum, *Bréb. in Ralfs, Brit. Desm.* p. 96, tab. 32. fig. 6.

Long. 37–42 μ; lat. ad bas. semicell. 23·5–27·5 μ; lat. ad apic. 7·5–8·5 μ; lat. isthm. 7·5 μ; crass. 15–17·5 μ.

I. Ballynahinch; Roundstone; near Recess; Creggan Lough; Lough Aunierin; Boy, Shindilla, and Nacoogarrow Loughs; Lakes east of Lough Bofin; near Westport; Baheh Loughs; Letereen Lough.—II. Glen Caragh; Adrigole.

Forma ad var. *concavum*, Lagerh. (Contrib. a la Fl. Alg. del Ecuador, ii. p. 16), accedens, lateribus subconcavis.

I. Derryclare Lough.

†Var. subgranatum, *Nord.* (*Alg. aq. dulc. Sandvic.* p. 13, tab. 2. fig. 8.)

Long. 24 μ; lat. 17 μ; lat. isthm. 6 μ.

I. Derryclare Lough.

11. C. angustatum, *Nord.* (*Desm. Arct.* p. 20.) [Euastrum binale, *Ralfs*, var. angustatum, *Wittr.* (*Gotl. och Öl. Sötv. Alg.* p. 50, tab. 4. fig. 8).—Euastrum polare, *Nord.* (*Desm. Spetsb.* p. 37, t. 7. f. 24).]

II. Cloonee Lough.

†12. C. trilobulatum, *Reinsch.* (*Alg. Fl.* p. 116, tab. 9. fig. 6.)

II. Cloonee Lough.

13. Cosmarium variolatum, *Lund.* (*Desm. Suec.* p. 41, tab. 2. fig. 19.)

Long. 32–34 μ; lat. 18–20 μ; lat. isthm. 5–6 μ.

I. Athry Lough; Ballynahinch.

Forma apice levissime retuso.

Long. 29 μ; lat. 16 μ; lat. isthm. 5 μ.

I. Lakes, Clifden to Roundstone.

†14. C. obsoletum, *Reinsch.* (*Alg. Fl.* p. 110, tab. 9. fig. 5.)

II. Clogerheen.

††Var. angustatum, nov. var. (Pl. XXIV. fig. 22.)

Var. longius quam latum, semicellulæ subcirculares, marginibus lateralibus subrectis, leviter productæ ad basin, apicibus incrassatis.

Long. 42·5 μ; lat. 34 μ; lat. isthm. 11 μ.

II. Carrantuohill.

15. C. pachydermum, *Lund.* (*Desm. Suec.* p. 39, tab. 2. fig. 15.)

I. Lough Aunierin.

†16. C. perforatum, *Lund.* (*Desm. Suec.* p. 40, tab. 2. fig. 16.)

Long. 60–75 μ; lat. 57–60 μ; lat. isthm. 26–32 μ.

I. Ballynahinch; Lakes east of Lough Bofin; Derryclare Lough; Lakes, Clifden to Roundstone.

17. C. circulare, *Reinsch.* (*Alg. Fl.* p. 108, tab. 10. fig. 2.)

Long. 90 μ; lat. 75 μ; lat. isthm. 25 μ.

I. Creggan Lough.

18. C. pyramidatum, *Bréb. in Ralfs, Brit. Desm.* p. 94, tab. 15. fig. 4.

Long. 58–100 μ; lat. 45–62 μ; lat. isthm. 17·5–20 μ.

I. Near Westport; Ballynahinch; Athry Lough; Lough Shindilla; near Recess; Roundstone; Lakes, Clifden to Roundstone; Oughterard; Arderry Lough; Lough Aunierin; Creggan and Boy Loughs; Nacoogarrow Lough.—II. Torc Mt.; Lower Lake of Killarney; Glen Caragh; Castletown; Sugar Loaf Mt.; Glengarriff; Cloonee Lough; Adrigole.

19. C. pseudopyramidatum, *Lund.* (*Desm. Suec.* p. 41, tab. 2. fig. 18.)

Long. 43–47 μ; lat. 25–28 μ; lat. isthm. 7–10 μ.

I. Athry Lough; Ballynahinch; Nacoogarrow Lough; Lakes, Clifden to Roundstone.—II. Muckross; Glen Caragh; Glengarriff; Lower Lake of Killarney; Adrigole; Carrantuohill.

††Forma SUBRECTANGULARIS. (Pl. XX. fig. 21.)

Forma semicellulis subrectangularibus; a latere visis pyramido-oblongis.

Long. 59 μ; lat. 30 μ; lat. isthm. 10 μ.

I. Derryclare Lough.

20. COSMARIUM GALERITUM, *Nord.* (*Desm. Brasil.* 1869, p. 209, tab. 3. fig. 26.)

I. Creggan and Letereen Loughs.

21. C. NITIDULUM, *De Not.* (*Desm. Ital.* p. 42, tab. 3. fig. 26.)

I. Derryclare Lough; Kylemore; Lakes, Clifden to Roundstone.—Lough Guitane; Sugar Loaf Mt.

22. C. PSEUDONITIDULUM, *Nord.* (*Norges Desm.* (1873), p. 16. tab. 1. fig. 4.)

II. Adrigole.

†23. C. ELFVINGII, *Racib.* (*Nonnul. Desm. Polon.* p. 27.) [C. hexagonum, *Elfv. non Nord.*]

I. Clifden.

24. C. PHASEOLUS, *Bréb.* (*Ralfs, Brit. Desm.* p. 106, tab. 32. fig. 5.)

I. Near Oughterard; Roundstone; Creggan and Nacoogarrow Loughs; Boy Lough; near Recess; Lakes, Clifden to Roundstone; Ballynahinch; Lough Aunierin.—II. Lough Guitane; Carrantuohill; Cloonee Lough; Adrigole; Mallow.

25. C. SCENEDESMUS, *Delp.* (*Desm. subalp.* p. 101, tab. 7. figs. 28–34.)

I. Near Westport; near Recess; Creggan Lough; Derryclare Lough; Nacoogarrow Lough; Lough Shannacloontippen; Boy and Oorid Loughs; Lakes east of Lough Bofin.—II. Muckross; Adrigole; Upper Lake of Killarney.

††Forma PUNCTATA.

F. membrana distincte punctata.

I. Derryclare Lough.

26. Cosmarium rectangulare, *Grun. in Rabh. Fl. Europ. Alg.* iii. p. 166. [C. gotlandicum, *Wittr. in Gotl. och Ol. Sötv. Alg.* p. 60, tab. 4. fig. 14.]

I. Ballynahinch; Nacoogarrow, Shindilla, Derryclare, and Letereen Loughs; Glendalough; Nabincka Lough.—II. Glen Caragh; Carrantuohill; Adrigole; Castletown; 8 m. S. of Kenmare.

27. C. bioculatum, *Bréb. in Ralfs, Brit. Desm.* p. 95, tab. 15. fig. 5.

I. Near Recess; Creggan Lough; Roundstone; Ballynahinch.—II. Lower Lake of Killarney; near Lough Brin; Mallow; Carrantuohill.

28. C. tinctum, *Ralfs.* (*Brit. Desm.* p. 95, tab. 32. fig. 7.)

Long. 10–13 μ; lat. 7·5–9 μ; lat. isthm. 4·5 μ; crass. 5 μ; diam. zygosp. 11–13 μ.

I. Ballynahinch; Roundstone (cum zygosp.); near Westport; Clifden; Lough Shannacloontippen; Derryclare Lough; Nacoogarrow Lough.—II. Upper and Lower Lakes of Killarney; Adrigole; Cloonee Lough; near Lough Brin; Glengarriff; Mallow.

††29. C. succisum, nov. sp. (Pl. XX. figs. 22, 23.)

C. parvum, tam longum quam latum, modice constrictum, sinu aperto cum extremo angusto et brevi; semicellulæ elliptico-hexagonæ, apice late truncatæ (nonnunquam subconcavo); a vertice visæ subellipticæ, medio leviter subtumidæ; a latere visæ circulares; membrana lævis et fere rufescens; pyrenoidibus singulis.

Long. 10–12·5 μ; lat. 11–12·5 μ; lat. isthm. 3·75–5 μ; crass. 6 μ.

I. Clifden; Creggan Lough; Derryclare Lough.

This species differs from *C. abbreviatum*, Racib. (De nonn. Desm. Poloniæ, p. 27, tab. 1. fig. 13), in its rufescent membrane, its smaller size, its different sinus, its relatively greater length, and in the slight central swelling of the vertical view. It differs from *C. pseudobiremum*, Boldt. (Siber. Chlor. tab. 5. fig. 6), in having the apex more truncate, in the less swollen middle of the end view, in the different sinus, as well as in its smaller size.

30. C. pygmæum, *Arch.* [Sphærozosma pygmæum, *Rabh. Fl. Europ. Alg.* iii. p. 150.] (Pl. XX. fig. 24.)

Long. 12·5–15 μ; lat. 10–12·5 μ; lat. isthm. 5 μ; crass. 4·5–7·5 μ; diam. zygosp. 12·5–15 μ.

I. Lough Aunierin (cum zygosp.).—II. Lough Guitane (cum zygosp.); near Lough Brin; Lower Lake of Killarney.

31. COSMARIUM TRUNCATELLUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 165.)

I. Moher Lough.

32. C. TENUE, *Arch.* (*Cooke, Brit. Desm.* p. 92.) (Pl. XX. fig. 25.)

Long. 14–16 μ; lat. 13·5–15·5 μ; lat. isthm. 3·5–4·5 μ; crass. 8·5 μ; diam. zygosp. 22–23 μ.

This agrees well with Archer's description of the species; it is about as long as broad and has a colourless membrane.

I. Lakes east of Lough Bofin (cum zygosp.); Derryclare Lough (cum zygosp.).

33. C. EXIGUUM, *Arch.* (*Rabh. Fl. Europ. Alg.* iii. p. 164.)

Long. 25–29 μ; lat. 15–16 μ; lat. isthm. 3–4 μ; crass. 10 μ.

I. Athry Lough; Lough Aunierin; Lakes, Clifden to Roundstone; Lakes east of Lough Bofin; Ballynahinch; Derryclare Lough.—II. Carrantuohill; Castletown.

†34. C. IMPRESSULUM, *Elfv.* [C. Meneghinii, *Bréb.*, f. Reinschii, *Istv.* (*Diag. Alg. Nov. Hung.* p. 8).—C. Meneghinii, *Bréb.*, forma, *Reinsch* (*Contrib. Alg. et Fung.* p. 88, tab. 12. fig. 12 *a* et *b*).]

Long. 26–27 μ; lat. 17–18 μ; lat. isthm. 6–7 μ.

I. Ballynahinch; Baheh Loughs; Lakes near Recess; Boy Lough; Moher Lough; Derryclare Lough; Nacoogarrow Lough; Glendalough; Shindilla Lough.—II. Lough Guitane.

35. C. VENUSTUM, *Arch. in Pritch. Infus.* ed. 1861, p. 732.

I. Near Westport; near Oughterard; Lakes, Clifden to Roundstone; Ballynahinch; Athry Lough; Arderry Lough.—II. Lough Guitane; Glen Caragh; Lower Lake of Killarney.

†Forma. MINOR, *Wille.* (*Ferskv. Alg. f. Nov. Seml.* p. 43.)

Long. 21 μ; lat. 16 μ; lat. isthm. 6 μ.

I. Baheh Loughs.

††Var. HYPOHEXAGONUM, nov. var. (Pl. XXI. fig. 1.)

Semicellulæ truncato-pyramidatæ, marginibus lateralibus in-

signite tricrenatis; membrana distincte callosa ad apicem incisurarum parvarum et ad medium; a latere visæ late ovatæ.

Long. 36–38 μ; lat. ad bas. semicell. 23–25 μ; lat. ad apic. 17–18 μ; lat. isthm. 7·5–8·5 μ; crass. 16 μ.

I. Ballynahinch; Athry Lough.

The *Cosmarium venustum*, Arch. in Wolle's Desm. U. S. (p. 68, pl. 16. fig. 37), may be referred to a less crenate form of this variety. The thickening on the inside at the base of the notches makes this variety appear at first sight more deeply crenate than it really is.

††Var. HYPOHEXAGONUM, nov. var., f. INCRASSATA. (Pl. XXIV. fig. 23.)

Forma subtricrenata, membrana forte incrassata inter undulas.

Long. 25 μ; lat. 20 μ; lat. isthm. 5 μ; crass. 11 μ.

I. Athry Lough.

††36. COSMARIUM PERPUSILLUM, nov. sp. (Pl. XXI. fig. 2.)

C. minutum, paulo longius quam latum, profundissime constrictum, sinu lineari angusto, extremo ampliato; semicellulæ subhexagonæ, marginibus lateralibus superioribus triundulatæ (angulos includente), apice late truncatæ et subconcavæ; a vertice visæ ellipticæ; a latere visæ subquadratæ, angulis rotundatis; membrana lævis; pyrenoidibus singulis.

Long. 11 μ; lat. 9·5 μ; crass. 5 μ.

I. Ballynahinch.

Compare with *C. Meneghinii*, Bréb., var. *nanum*, Wille (Ferskv. Alg. f. Nov. Seml. p. 43, tab. 13. fig. 37).

37. C. MENEGHINII, *Bréb. in Ralfs, Brit. Desm.* p. 96, tab. 15. fig. 6.

I. Moher Lough; near Recess; Lough Aunierin; Derryclare and Nabincka Loughs; Lough Shindilla; Lakes east of Lough Bofin.—II. Lough Guitane; Cromagloun; Upper and Lower Lakes of Killarney; Carrantuohill; Kenmare; Glengarriff; Glen Caragh; Cloonee Lough; Mallow; 8 m. S. of Kenmare.

Forma OCTANGULARIS, *Wille.* (*Ferskv. Alg. från Nov. Seml.* p. 43, tab. 12. fig. 35.)

I. Creggan Lough; Ballynahinch; near Westport; Lakes E. of Lough Bofin.—II. Upper and Lower Lakes of Killarney; Cloonee Lough; Mallow.

†Var. NANA, *Wille.* (*Ferskv. Alg. från Nov. Seml.* tab. 13. fig. 37.)

II. Cromagloun.

†Var. WOLLEI, *Lagerh.* (*Desmid. aus Bengal.* p. 8.) [C. Meneghinii, *Wolle* (*Desm. U. S.* tab. 16. fig. 7, sinistra, superior).] (Pl. XXIV. fig. 18.)

Long. 15–17·5 μ; lat. 11–13 μ; lat. isthm. 3–4·5 μ.

I. Roundstone.—II. Cromagloun; Upper Lake of Killarney; Carrantuohill.

†38. COSMARIUM PROMINULUM, *Racib.* (*Nonn. Desm. Polon.* p. 23, tab. 2. fig. 7.)

II. Glen Caragh.

†39. C. CONCINNUM, *Reinsch*, var. LÆVE, *Wille.* (*Bidrag til Kunds. om Norges Ferskv. Alg.* p. 30, tab. 1. fig. 12.)

Long. 10–11 μ; lat. 7·5-8 μ; lat. isthm. 2–3 μ; crass. 4–5 μ.

I. Derryclare Lough; Ballynahinch; Lakes E. of Lough Bofin.—II. Adrigole.

40. C. OBLIQUUM, *Nord.* (*Norges Desm.* p. 23, tab. 1. fig. 8.)

I. Creggan Lough; Lakes E. of Lough Bofin.—II. Carrantuohill.

††Var. TRIGONUM, nov. var. (Pl. XXIV. fig. 15.)

Semicellulæ a vertice visæ trigonæ, lateribus suberectis.

Long. 17·5 μ; lat. 14 μ; lat. isthm. 7·5 μ.

II. Carrantuohill.

41. C. REGNESII, *Reinsch.* (*Alg. Fl.* p. 112, tab. 7. fig. 8.)

Long. 13·5–14 μ; lat. 12–13·5 μ; lat. isthm. 4·5–6 μ.

I. Near Westport; Ballynahinch; Athry Lough; Roundstone; Clifden; Lough Shannacloontippen.—II. Upper Lake of Killarney; Carrantuohill; near Lough Brin; Adrigole; Cloonee Lough.

††Var. TRITUM, nov. var. (Pl. XXI. fig. 3.)

Hæc forma typica differt absentia dentium parvorum.

Long. 12·5 μ; lat. 12 μ; lat. isthm. 6 μ; crass. 6 μ.

I. Creggan Lough; Kylemore.

42. C. SUBSTRIATUM, *Nord. in Wittr. et Nord. Alg. Exsic.* no. 977.

Pyrenoidibus singulis.

Long. 14–17 μ; lat. 14–16 μ; lat. isthm. 5 μ.

I. Lough Shannacloontippen; near Recess; Ballynahinch; Moher Lough; near Oughterard; near Westport; Lakes, Clifden to Roundstone; Creggan Lough; Derryclare Lough; Lakes east of Lough Bofin; Nabincka and Nacoogarrow Loughs; Roundstone; Boy Lough; Letereen Lough; Baheh Loughs; Glendalough; Lough Shindilla.—II. Lough Guitane; Upper and Lower Lakes of Killarney; Kenmare; Adrigole; Cloonee Lough.

††43. COSMARIUM SUBDANICUM, nov. sp. (Pl. XXI. fig. 4.)

C. parvum, circiter tam longum quam latum, incisura mediana profunda lineari (extremo ampliata); semicellulæ subtrapezicæ, in lateribus subconvexis binis papillis brevissimis emarginatis instructæ, in apice truncato quinque crenis levissimis præditæ; a vertice visæ ellipticæ, medio leviter subtumidæ; a latere visæ subcirculares; membrana lævis; pyrenoidibus singulis.

Long. 17·5 μ; lat. ad bas. semicell. 14 μ; lat. ad apic. 11 μ; lat. isthm. 4 μ; crass. 8·5 μ.

I. Ballynahinch.

This is similar to *C. danicum*, Boerg. (Bidrag til Bornholms Desmidie-Flora, p. 145, tab. 6. fig. 6), but the sides differ in not having such a large subapical notch as well as in the lack of granules. It is also similar to *C. bipunctatum*, Boerg. (Desm. Brasil. p. 945, tab. 4. fig. 33), in outline, but differs in its margin, its smooth membrane, and in its faint monosubpapillate central protuberance.

44. C. CRENATUM, *Ralfs*. (*Brit. Desm.* p. 96, tab. 15. fig. 7.)

I. Oorid Lough.—II. Lough Guitane; Carrantuohill; Glen Caragh; Castletown; near Lough Brin; Cloonee Lough; 8 m. S. of Kenmare.

45. C. SUBCRENATUM, *Hantzsch*. (*Rabh. Fl. Europ. Alg.* iii. p. 164; *Nord. Desm. Arct.* p. 21, tab. 6. figs. 10, 11.)

Long. 33 μ; lat. 30 μ; lat. isthm. 11 μ.

II. Muckross; Carrantuohill; Cloonee Lough.

†Var. DIVARICATUM, *Wille*. (*Ferskv. Alg. från Nov. Seml.* p. 40, tab. 12. fig. 27.)

Forma crenis lateralibus sub-bidentulatis, et granulæ semicellularum in series 3 verticales dispositæ.

I. Creggan Lough.

††46. COSMARIUM NUTTALLII, nov. sp. (Pl. XXI. fig. 5.)

C. mediocre, diametro circiter $1\frac{1}{2}$plo longius, modice constrictum, sinu sublineari et introrsum ampliato; semicellulæ subsemiorbiculares, angulis inferioribus subrectangularibus in ambitu (10) undulatæ, granulis 4 intra utrumque marginem lateralem (uno sub utraque duarum inferiorum undularum et duobus sub undula tertia de basi), et 4 ad apicem (uno utroque parvo sinui, quarto infra granulum centralem); a vertice visæ subellipticæ, polis truncatis leviter tetraundulatis, medio inflatæ; a latere visæ quadrato-ovales, apice tetraundulatæ, inflatæ versus basin; isthmus a vertice visæ oblongo-truncatus; membrana dense et minute punctata, medio lævi et incrassato; pyrenoidibus binis.

Long. 45 μ; lat. 32 μ; isthm. 16×11 μ; crass. 23 μ.

I. Ballynahinch; Athry Lough; Clifden.

This can be compared with its nearest ally *C. subundulatum*, Wille (Bg. til Kunds. om Norges Ferskv. Alg. p. 27, tab. 1. fig. 9).

Named after my botanical companion in these and many other tours, Wm. Nuttall.

47. C. UNDULATUM, *Corda.* (*Alm. de Carlsbad*, 1839, p. 243, tab. 5. fig. 26; *Ralfs*, *Brit. Desm.* p. 97, tab. 15. fig. 8.)

I. Near Westport; Creggan Lough; Lough Aunierin; Lakes, Clifden to Roundstone.—II. Carrantuohill.

††Var. WOLLEI, nov. var. [C. undulatum, *Corda*, var. crenulatum, *Wolle* (*Desm. U. S.* p. 67, tab. 16. figs. 10, 19, 20), non *Wittr.* (*Anteckn. om Skand. Desm.* 1869, p. 11).]

I. Near Oughterard.

48. C. MONOMAZUM, *Lund.* (*Desm. Suec.* p. 32, tab. 3. f. 11.)

Var. POLYMAZUM, *Nord.* (*Sydl. Norges Desm.* p. 14, tab. 1. fig. 3.)

Long. 37·5 μ; lat. 33–34 μ; lat. isthm. 10–12 μ; crass. 20 μ.

I. Ballynahinch; Lough Aunierin.

49. C. TETRAOPHTHALMUM, *Bréb. in Ralfs, Brit. Desm.* p. 98, tab. 17. fig. 11, tab. 33. fig. 8.

Long. 103–111 μ; lat. 72–77 μ; lat. isthm. 18–23 μ; crass. 48 μ.

I. Creggan Lough; Lough Aunierin; Lough Shannacloontippen; Arderry Lough; Athry Lough; Derryclare Lough;

Baheh Loughs; Lakes, Clifden to Roundstone; Ballynahinch.—II. Muckross; Kenmare; Lower Lake of Killarney.

†Var. LUNDELLII, *Wittr.* (*Gotl. och Ol. Stöv. Alg.* p. 56.) [C. tetraophthalmum, *Bréb.*, forma, *Lund* (*Desm. Suec.* p. 27).]

I. Ballynahinch; Creggan Lough; Roundstone; near Westport; Nacoogarrow Lough; Shindilla Lough.—II. Lough Guitane; Glengarriff.

50. COSMARIUM BREBISSONII, *Menegh.* (*Ralfs, Brit. Desm.* p. 100, tab. 16. fig. 3.)

I. Ballynahinch; Lough Aunierin; near Oughterard; Derryclare Lough; Roundstone; Oorid Lough; near Recess; Nacoogarrow Lough.—II. Lough Guitane; Glengarriff; Upper and Lower Lakes of Killarney.

††Forma EROSA. (Pl. XXI. fig. 6.)

F. dorso subglabrato et subtruncato.

Long. 95 μ; lat. 70 μ; lat. isthm. 25 μ; crass. 47·5 μ.

I. Derryclare Lough.—II. Lough Guitane; Glengarriff; Carrantuohill.

51. C. CONSPERSUM, *Ralfs.* (*Brit. Desm.* p. 101, tab. 16. fig. 4.)

I. Creggan Lough; Roundstone; Lakes, Clifden to Roundstone.—II. Adrigole.

††Var. SUBROTUNDATUM, nov. var. (Pl. XXI. fig. 7.)

Var. angulis superioribus semicellularum rotundatioribus quam in var. *rotundato*, Wittr. (Anteck. Skand. Desm. p. 13, fig. 4); granulis numerosioribus in series horizontales (circiter 12), in series verticales (circiter 21) ordinatis.

Long. 84 μ; lat. 82 μ; lat. isthm. 30 μ; crass. 42 μ.

II. Cromagloun.

52. C. MARGARITIFERUM, *Menegh.* (*Ralfs, Brit. Desm.* p. 100, tab. 16. fig. 2.)

I. Near Westport; Boy Lough.—II. Clogerheen; Glengarriff; Guitane and Cloonee Loughs.

53. C. PORTIANUM, *Arch.* (*Pritch. Infus.* ed. 1861, p. 733.)

Long. 33 μ; lat. 29 μ; lat. isthm. 8·5 μ.

I. Lakes, Clifden to Roundstone, and E. of Lough Bofin;

Aunierin; Shannacloontippen and Derryclare Loughs; near Westport.—II. Lough Guitane; Glengarriff; near Lough Brin; Carrantuohill; Kenmare; Adrigole.

†Var. NEPHROIDEUM, *Wittr.* (*Om Gotl. och Ol. Sötvatt.* p. 57.)

I. Lakes E. of Lough Bofin.

54. COSMARIUM RENIFORME, *Arch.* [C. margaritiferum, *Menegh.*, β. reniforme, *Ralfs*, *Brit. Desm.* p. 100, tab. 16. fig. 2 *a*.]

Long. 57 μ; lat. 44 μ; lat. isthm. 16 μ.

I. Creggan Lough; near Westport; Ballynahinch; Lough Aunierin; Lakes near Recess and E. of Lough Bofin; Derryclare Lough; Nacoogarrow Lough.—II. Lough Guitane; Kenmare; Cloonee Lough; Carrantuohill; 8 m. S. of Kenmare.

††55. C. SPHÆROIDEUM, nov. sp. (Pl. XXI. fig. 8.)

C. mediocre, diametro 1½plo longius, profunde constrictum, sinu angusto introrsum fere ampliato; semicellulæ late ovales et subcomplanatæ ad basin; granulis magnis in quincuncem ordinatis (circiter 11 obliquis seriebus); a vertice conspectæ ellipticæ; a latere visæ subrotundæ; pyrenoidibus binis.

Long. 63 μ; lat. 38 μ; lat. isthm. 10–14 μ; crass. 27 μ.

I. Arderry Lough.—II. Cromagloun; Glen Caragh; Castletown.

Compare with *C. logiense*, Biss., and *C. margaritiferum*, Menegh.

56. C. LOGIENSE, *Biss.* (*Journ. Roy. Micr. Soc.* 1884, p. 194, tab. 5. fig. 4.)

I. Roundstone.—II. Cloonee Lough; Carrantuohill; Castletown.

57. C. PUNCTULATUM, *Bréb.* (*Nord. Desm. Spetsb.* p. 26, tab. 6. fig. 1.)

I. Near Westport; Roundstone; Lakes near Recess; Lakes Clifden to Roundstone; Derryclare Lough; Ballynahinch; Nacoogarrow Lough.—II. Lower Lake of Killarney; Carrantuohill.

†58. C. BIPUNCTATUM, *Boerg.* (*Desm. Brasil.* p. 945, tab. 4. fig. 33.)

I. Near Westport.

†59. Cosmarium subpunctulatum, *Nord.* (*Fr. Wat. Alg. of New Zeal. & Austr.* p. 47, tab. 5. fig. 8.)

I. Near Westport.

††Var. Boergesenii, nov. var. [C. subpunctulatum, *Nord.*, forma, *Boerg.* (*Bidrag til Bornh. Desmidie-Flora*, p. 144, tab. 6. fig. 4).] (Pl. XXI. fig. 9.)

A forma typica differt granulis validioribus, iis (circiter 8) ad medium submajoribus, seriebus transversis duabus, apicibus distincte sed minute granulatis.

Long. 29 μ; lat. 28 μ; lat. isthm. 9 μ.

I. Lakes, Clifden to Roundstone; Ballynahinch.

†60. C. Arnellii, *Boldt.* (*Siber. Chlor.* Taf. 5. fig. 15.)

††Forma compressa. (Pl. XXI. fig. 10.)

Forma parvior relative latior quam forma typica, seriebus transversis granulorum validioribus et propioribus basi semicellularum.

Long. 42 μ; lat. 37 μ; lat. isthm. 16 μ.

I. Lakes, Clifden to Roundstone.

61. C. Blyttii, *Wille.* (*Bidrag til Kundsk. om Norg. Ferskv.* p. 25, tab. 1. fig. 7.)

I. Athry Lough; Glendalough; Letereen Lough; Lough Aunierin.—II. Lough Guitane; near Lough Brin; Cloonee Lough; Adrigole.

††62. C. synthlibomenum, nov. sp. (Pl. XXI. fig. 11.)

C. perpusillum, circiter tam longum quam latum, leviter constrictum, sinu lato et obtuso; semicellulæ ellipticæ et compressæ, granulis parvis exilibus decem circiter in ambitu; a vertice visæ ellipticæ; a latere visæ subcirculares; membrana leviter et sparsim subgranulata; pyrenoidibus binis.

Long. 12–12·5 μ; lat. 11–12·5 μ; lat. isthm. 8–9 μ; crass. 6–8 μ.

I. Ballynahinch.

This is much smaller than *C. orthostichum*, Lund, var. *pumilum*, Lund (Desm. Suec. p. 25, tab. 2. fig. 10), which it somewhat resembles; but differs in the longitudinally compressed cells and in its much broader isthmus as well as in its *binate pyrenoids*, and much fainter granules, and other characters. It is distinct from *C. sphalerostichum*, Nord. (Nord. et Wittr.

Desm. et Œdog. in Tyrol, p. 29, tab. 12. fig. 3), and *Cosmarium brasiliense*, Nord. (Fr. Wat. Alg. of New Zeal. and Austr. p. 51), in its very different sinus, apex, and other characters.

63. Cosmarium orthostichum, *Lund.* (*Desm. Suec.* p. 24, tab. 2. fig. 9.)

I. Ballynahinch.—II. Glengarriff.

64. C. botrytis, *Menegh.* (*Ralfs, Brit. Desm.* p. 99, tab. 16. fig. 1.)

I. Near Westport; Lough Shindilla; Nabincka and Creggan Loughs; Lakes E. of Lough Bofin.—II. Lower Lake of Killarney; Lough Guitane; Mallow; 8 m. S. of Kenmare; Glengarriff.

††Var. mediolæve, nov. var. (Pl. XXI. fig. 12.)

Semicellulæ apice subtruncato subretuso glabrato, granulis concentrice et radiate dispositis, medium versus parvioribus, ad medium glabræ; a vertice visæ ellipticæ, lateribus compressis; a latere visæ oblongo-ellipticæ, lateribus subrectis; pyrenoidibus binis.

Long. 65–70 μ; lat. 55–59 μ; lat. isthm. 15 μ; crass. 25–27 μ.

I. Lakes, Clifden to Roundstone; near Westport; Nacoogarrow Lough.—II. Clogerheen.

65. C. eboracense, *West.* (*Freshwater Algæ N. Yorks., Journ. Bot.* Oct. 1889, tab. 291. fig. 1.)

II. Cloonee Lough; Kenmare.

66. C. Turpinii, *Bréb.*, var. Lundellii, *Gutw.* [C. Turpinii, *Breb.*, forma, *Lund* (*Desm. Suec.* p. 29).]

Long. 50–63 μ; lat. 45–62 μ; lat. isthm. 19–21 μ; crass. 28–33 μ.

I. Near Westport.—II. Lower Lake of Killarney.

†67. C. formulosum, *Hoff. in Nord. Desm. från Bornholm*, p. 194, tab. 6. figs. 6–7.

I. Lough Aunierin.—II. Cloonee Lough.

68. C. præmorsum, *Bréb. in Pritch. Infus.* ed. 1861, p. 733.

I. Near Westport; Lakes, Clifden to Roundstone.

69. COSMARIUM BROOMEI, *Thw. in Ralfs, Brit. Desm.* p. 103, tab. 16. fig. 6, tab. 33. fig. 7.

I. Near Westport.

70. C. CONFUSUM, *Cooke*, var. REGULARIUS, *Nord.* (*Fr. Wat. Alg. of New Zeal. & Austr.* p. 47, tab. 5. fig. 6.)

I. Lakes near Recess; Arderry Lough; Lakes, Clifden to Roundstone; Derryclare Lough; Lough Aunierin; Creggan Lough; Oorid Lough; Lakes east of Lough Bofin; Nacoogarrow Lough; Boy Lough.—II. Muckross; Upper Lake of Killarney; Glen Caragh; Glengarriff.

††*AMBIGUUM, nov. subsp. (Pl. XXI. fig. 13.)

C. mediocre, diametro quarto parte longius, profunde constrictum, sinu lineari extremo ampliato; semicellulæ breviter subpyramidatæ, late truncatæ ad apicem, angulis inferioribus et superioribus rotundatis, granulis magnis subconcentrice ordinatis (nudæ ad apicem); a vertice visæ ellipticæ; a latere visæ circulares, granulis in circiter 6 seriebus transversis longitudinalibusque; pyrenoidibus binis.

Long. 50–52 μ; lat. 42–43 μ; lat. isthm. 12–13 μ; crass. 28 μ.

I. Ballynahinch; Creggan Lough; Derryclare Lough; Lough Aunierin.—II. Cromagloun; Upper Lake of Killarney.

71. C. AMŒNUM, *Bréb. in Ralfs, Brit. Desm.* p. 102, tab. 17. fig. 3.

Long. 46–49 μ; lat. 21–25 μ; lat. isthm. 8–12 μ; crass. 17–18 μ.

I. Roundstone; Ballynahinch; Arderry Lough; near Oughterard; near Westport; Lakes, Clifden to Roundstone; Lakes east of Lough Bofin; Derryclare Lough; Lough Aunierin; Athry Lough.—II. Cromagloun; near Lough Brin.

†Var. MEDIOLÆVE, *Nord.* (*Fr. Wat. Alg. of New Zeal. & Austr.* p. 50, tab. 5. fig. 12.)

Long. 52 μ; lat. 32 μ; lat. isthm. 16 μ.

I. Ballynahinch.

†72. C. PSEUDAMŒNUM, *Wille.* (*Bidrag til Sydamerik. Alg. Fl.* p. 18, tab. 1. fig. 37.)

I. Clifden.

73. COSMARIUM CYLINDRICUM, *Ralfs.* (*Annals of Nat. Hist.* vol. xiv. p. 392, tab. 11. fig. 1; *Brit. Desm.* p. 106, tab. 17. fig. 4.)

I. Athry Lough.

74. C. ANNULATUM, *De Bary.* [Dysphinctium annulatum, *Neag.* (*Einz. Alg.* p. 110, tab. 6. fig. F).]

Long. 44·5 μ; lat. max. 16 μ; lat. ad apic. 14 μ.

I. Nacoogarrow Lough.—II. Carrantuohill; Adrigole.

†75. C. SUBCOSTATUM, *Nord.* (*Wittr. et Nord. Desm. et Œdog. in Tyrol*, p. 37, tab. 12. fig. 13.)

I. Derryclare Lough.—II. Lower Lake of Killarney.

†76. C. SUBPROTUMIDUM, *Nord.* (*Wittr. et Nord. Desm. et Œdog. in Tyrol*, p. 38, tab. 12. fig. 14.)

Forma. (Pl. XXIV. fig. 21.)

Long. 32 μ; lat. 25 μ; lat. apic. 14 μ; lat. isthm. 8·5 μ.

I. Lakes, Clifden to Roundstone.

77. C. BOECKII, *Wille.* (*Bidrag til Kundsk. om Norges Ferskv.* p. 28, tab. 1. fig. 10.)

I. Ballynahinch; Lough Aunierin; Nacoogarrow, Nabincka, and Shindilla Loughs; Derryclare Lough.—II. Carrantuohill; Adrigole; Kenmare; Mallow.

††*BIPAPILLATUM, nov. subsp. (Pl. XXI. fig. 14.)

C. mediocre, paulo longius quam latum, profunde constrictum, sinu angusto et lineari; semicellulæ semicircularo-trapezicæ, dorso truncatæ et tetraundulatæ, granulis circiter quinque ad marginem lateralem unumquemque, granulorum seriebus duobus intra marginem; series exterior granulis 13, series interior interrupta granulis 7, in medio cum papillis binis longitudinaliter dispositis; a vertice visæ ellipticæ, papillam medianam unam ostendens; a latere visæ subcirculares, utrobique papillis binis.

Long. 34 μ; lat. 28 μ; lat. isthm. 9 μ; crass. 17 μ.

I. Creggan Lough.

78. C. SPHALEROSTICHUM, *Nord. in Nord. et Wittr. Desm. Ital.* p. 28, tab. 12. fig. 3; *Cooke, Brit. Desm.* p. 111, tab. 42. fig. 6.

I. Kylemore; Lakes east of Lough Bofin; Derryclare and

Nacoogarrow Loughs.—II. Loughs Guitane and Cloonee; Lower Lake of Killarney; Carrantuohill; Glengarriff.

79. Cosmaritum cœlaum, *Ralfs.* (*Brit. Desm.* p. 103, tab. 17. fig. 1.)

Long. 40–45 μ; lat. 36–37 μ; lat. isthm. 12–13 μ.

I. Near Westport; Kylemore; Glendalough; Nacoogarrow Lough.—II. Carrantuohill; Upper and Lower Lakes of Killarney; Glengarriff; Castletown; 8 m. S. of Kenmare.

80. C. ornatum, *Ralfs, in Annals of Nat. Hist.* vol. xiv. p. 392, tab. 11. fig. 3; *Brit. Desm.* p. 104, tab. 16. fig. 7.

I. Ballynahinch; Athry Lough; Roundstone; Lough Aunierin; Lough Shannacloontippen; near Westport Lakes east of Lough Bofin; Derryclare Lough.—II. Muckross; Upper Lake of Killarney; Lough Guitane; Adrigole.

81. C. Kjellmanni, *Wille.* (*Ferskv. Alg. fr. Nov. Seml.* p. 42, tab. 12. fig. 31.)

II. Near Lough Brin.

†Var. ornatum, *Wille.* (*L. c.* p. 42, tab. 12. fig. 32.)

Forma granulis in series 4 verticales dispositis.

I. Athry Lough.

82. C. commissurale, *Bréb.*, †var. crassum, *Nord.* (*Desm. Brasil.* tab. 3. fig. 19.)

II. Cromagloun; Glen Caragh.

Agreeing exactly with Nordstedt's figure, with the exception that the aperture of the sinus is closed.

83. C. quinarium, *Lund.* (*Desm. Suec.* p. 28, tab. 2. fig. 14.)

I. Ballynahinch.—II. Kenmare; near Lough Brin.

84. C. quadrifarium, *Lund.* (*Desm. Suec.* p. 32, tab. 3. fig. 12.)

Long. 47·5–57·5 μ; lat. 34–38 μ; lat. isthm. 10–12·5 μ; crass. 20 μ.

I. Kylemore.—II. Castletown; Carrantuohill; Adrigole.

Forma hexasticha, *Nord.* (*Fr. Wat. Alg. of New Zeal. & Austr.* p. 49). [C. hexastichum, *Lund* (*Desm. Suec.* p. 33, tab. 3. fig. 13).]

I. Ballynahinch.—II. Adrigole.

†85. Cosmarium radiosum, *Wolle.* (*Desm. U. S.* p. 90, tab. 19. figs. 21, 22.)

Long. 55 μ; lat. 45 μ; lat. isthm. 12 μ.

I. Creggan Lough.

86. C. speciosum, *Lund*, var. simplex, *Nord.* (*Desm. Spetsb.* p. 31, tab. 6. fig. 12.)

II. Carrantuohill.

87. C. subspeciosum, *Nord.* (*Desm. Arct.* p. 22, tab. 6. fig. 13.)

I. Creggan Lough.

88. C. notabile, *Bréb.*, f. minor, *Wille.* (*Ferskv. Alg. fr. Nov. Seml.* p. 36, tab. 12. fig. 17.)

Long. 28 μ; lat. 20 μ; lat. isthm. 15 μ; crass. 11 μ.

I. Near Westport.

89. C. orbiculatum, *Ralfs, in Annals of Nat. Hist.* vol. xiv. p. 392, tab. 11. fig. 2; *Brit. Desm.* p. 107, tab. 17. fig. 5.

Long. 35 μ; lat. 19 μ; lat. isthm. 8 μ.

I. Ballynahinch.—II. Carrantuohill.

90. C. isthmium, *West.* (*Fr. Wat. Alg. of North Wales*, p. 290, pl. 5. fig. 19.) [C. excavatum, *Nord.*, f. duplomajor, *Lund* (*Desm. Suec.* p. 46); *Wolle* (*Desm. U. S.* p. 77, pl. 53. figs. 14, 15); *Wille* (*Ferskv. Alg. f. Nov. Seml.* p. 47).]

†† Forma hibernica. (Pl. XXI. fig. 15.)

Forma major, angulis inferioribus rotundatioribus, isthmo latiore; pyrenoidibus singulis et magnis.

Long. 50–53 μ; lat. 31 μ; lat. isthm. 19–21 μ.

I. Ballynahinch.—II. Sugar Loaf Mt.; Castletown; Glengarriff.

The dimensions of the Welsh specimens here considered as type were:—Long. 40 μ; lat. 25–26 μ; lat. isthm. 11 μ.

Although this species has been placed under *C. excavatum*, Nord. (Desm. Brasil. tab. 3. fig. 25), by several writers, it is distinct. *C. excavatum* is much smaller, and it is much longer relatively, moreover the form of its median excavation is so different. Mr. Bennett (Journ. Royal Micr. Soc., June 1890, p. 305), reasoning from the figure and description, considers it as a dividing form of *C. orbiculatum*, Ralfs; however, many

examples were seen, and none of them showed any signs of the familiar characteristic appearance appertaining to stages of division.

I also think that *Cosmarium excavatum*, Nord., var. *ellipticum*, Wille (Ferskv. Alg. fr. Nov. Seml. p. 47, tab. 13. fig. 46), is a variety of *C. isthmium*, as his measurements (long. 29 μ; lat. 23 μ; crass. 20 μ; lat. isthm. 11 μ) come nearer to a shortened form of it, moreover its granules and excavation are much nearer to those of the latter; I propose to call it var. *Willei*, nob. Prof. Lagerheim (Bidrag til Amerikas Desmidié-Flora) enumerates *C. excavatum*, Nord., and gives the following measurements:—Long. 44 μ; lat. 24 μ; lat. isthm. 12 μ: judging from these dimensions, the plant he describes seems to belong to *C. isthmium* rather than to *C. excavatum*. The var. *trigonum*, Lagerh. (*l. c.*), of the latter species is so widely different in comparative length and breadth (long. 20 μ; lat. 18 μ; crass. 18 μ; lat. isthm. 13 μ) as well as in its trigonal vertical aspect, that it is probably a distinct species, and may possibly belong to the genus *Staurastrum*.

91. Cosmarium moniliforme, *Ralfs*. (*Brit. Desm.* p. 107, tab. 17. fig. 6.)

Long. 21–28 μ; lat. 11–13 μ; lat. isthm. 4–8 μ.

I. Near Oughterard; Creggan Lough; Lakes, Clifden to Roundstone; Lakes east of Lough Bofin; Ballynahinch; Derryclare Lough.—II. Cromagloun; Glen Caragh; Lower Lake of Killarney; Adrigole; Cloonee Lough.

Forma semicellulis subrotundatis (levissime subangularibus).

Long. 38–42 μ; lat. 18–20 μ; lat. isthm. 4–5 μ.

I. Ballynahinch.

92. C. contractum, *Kirch*. (*Wolle, Desm. U. S.* p. 63, tab. 16. fig. 1, tab. 50. fig. 24.)

I. Ballynahinch; Clifden; Lough Aunierin.—II. Cromagloun; Torc Mt.; Adrigole.

93. C. globosum, *Buln.*, *in Hedwigia*, vol. ii. p. 52, tab. 9. fig. 8.

Long. 30 μ; lat. 25 μ; lat. isthm. 17·5 μ.

I. Lakes east of Lough Bofin.

94. Cosmarium connatum, *Bréb. in Ralfs, Brit. Desm.* p. 108, tab. 17. fig. 10.

I. Ballynahinch; Lough Aunierin; Lakes near Recess; Lakes, Clifden to Roundstone; Derryclare Lough; Lakes E. of Lough Bofin.

††Var. truncatum, nov. var. (Pl. XXI. fig. 16.)

Var. apicibus truncatis et incisura mediana profundiore constricta.

Long. 105 μ; lat. 75 μ; lat. isthm. 45 μ.

I. Derryclare Lough.

95. C. pseudoconnatum, *Nord.* (*Desm. Brasil.* p. 214, tab. 3. fig. 17.)

Long. 47·5–51 μ; lat. 33–38 μ; lat. isthm. 31–32·5 μ.

I. Ballynahinch; Athry Lough; Lakes east of Lough Bofin. —II. Muckross; Upper Lake of Killarney; Adrigole.

††Var. constrictum, nov. var. (Pl. XXI. fig. 17.)

Var. insignis et major, a forma typica differt multum profundiore constrictione.

Long. 65 μ; lat. 43 μ; lat. isthm. 26 μ.

I. Ballynahinch.

†96. C. viride, *Joshua, in Journ. Bot.* Feb. 1885, tab. 254. fig. 3.—Colpopelta viridis, *Corda, Almanac de Carlsbad*, 1835, p. 206, tab. 2. fig. 28.—Cosmarium Cordanum, *Bréb. in Pritch. Inf.* ed. 1861; *W. Turner, in Journ. Roy. Micr. Soc.* Dec. 1885, p. 934, tab. 15. fig. 4; *West, in Journ. Roy. Micr. Soc.* Feb. 1889, p. 18, tab. 3. fig. 23.

††Forma minor.

Long. 31–32·5 μ; lat. 18–19 μ; lat. isthm. 12·5–15 μ.

I. Derryclare Lough; Ballynahinch.

The following is a comparative list of the published dimensions of this species:—

	Long.	Lat.	Lat. isthm.
Joshua (examples from Nova Scotia)	55 μ	30–33 μ	22 μ
Turner (examples from Nova Scotia)	47–50 μ	26–27 μ	17–19 μ
West (examples from Massachusetts)	41–45 μ	20–25 μ	14–20 μ

†97. COSMARIUM ARCTOUM, *Nord.* (*Desm. Arct.* p. 28, tab. 7. fig. 22.)

††Forma MINOR. (Pl. XXIV. fig. 24.)

Long. 12·5 μ; lat. 10 μ; lat. isthm. 8·5 μ; crass. 7·5 μ.

I. Ballynahinch.

98. C. PSEUDARCTOUM, *Nord. in Nord. & Wittr., Alg. Exsicc.* no. 257.

I. Ballynahinch.—II. Carrantuohill; near Lough Brin.

99. C. CUCURBITA, *Bréb.* (*Ralfs, Brit. Desm.* p. 108, tab. 17. fig. 7.)

I. Creggan Lough; Kylemore; Ballynahinch; Roundstone; Oorid Lough; near Oughterard.—II. Cromagloun; Torc Mt.; Lower Lake of Killarney; Carrantuohill; Adrigole; near Lough Brin.

††Forma MAJOR. (Pl. XXIV. fig. 25.)

Long. 60 μ; lat. 30 μ; lat. isthm. 25 μ.

I. Ballynahinch.

100. C. PALANGULA, *Bréb.* (*Rabh. Fl. Europ. Alg.* iii. p. 174; *Cooke, Brit. Desm.* p. 125, tab. 44. fig. 9.)

II. Lower Lake of Killarney; Glen Caragh.

Var. DE-BARYI, *Rabh.* (*Fl. Europ. Alg.* iii. p. 175.)

Long. 46 μ; lat. 22 μ.

I. Clifden; Ballynahinch.

††101. C. OBCUNEATUM, nov. sp. (Pl. XXI. fig. 18.)

C. parvum, circiter 3plo longius quam latius, medio leviter constrictum; semicellulæ oblongo-pyramidatæ, truncatæ et subretusæ ad apicem; a vertice conspectæ circulares; membrana irregulariter punctata.

Zygosporæ globosæ, aculeis simplicibus longis munitæ.

Long. 42 μ; lat. lad bas. semicell. 15 μ; at. ad apic. 10 μ; diam. zygosp. 29 μ; long. acul. 10–12 μ.

II. Cromagloun.

This appears to me to be sufficiently distinct from *C. palangula*, Bréb. I have met with *C. Cucurbita*, Bréb., in conjugation from West Yorks. (*vide* "Additions to Freshw. Alg. of W. Yorks.," in 'Naturalist,' Aug. 1891, p. 246), and from the North-east of Ireland; the fully developed zygospores were globose and without spines.

This was only seen in zygospore, and the surrounding inseparable débris prevented the cytioderm of the semicells from being properly observed. The zygospore points to this being a *Cosmarium*, but the arrangement of the chlorophyll was not seen.

Compare with *Penium adelochondrum*, Elfv.

102. Cosmarium Thwaitesii, *Ralfs*. (*Brit. Desm.* p. 109, tab. 17. fig. 8.)

I. Lough Aunierin.—II. Sugar Loaf Mt.; Carrantuohill.

103. C. Ralfsii, *Bréb. in Ralfs, Brit. Desm.* p. 93, tab. 15. fig. 3.

I. Near Oughterard; near Recess; Kylemore.—II. Cromagloun; Torc Mt.; Carrantuohill; Castletown.

†Forma montanum, *Racib.* (*De nonn. Desm. Polon.* p. 15, tab. 1. fig. 4.)

II. Carrantuohill.

104. C. Cucumis, *Corda.* (*Alm. de Carlsbad*, 1835, p. 121, fig. 27; *Ralfs, Brit. Desm.* p. 93, tab. 15. fig. 2.)

Zygosporæ globosæ, glabræ.

Long. 54–57 μ; lat. 30–31 μ; lat. isthm. 10–12 μ; diam. zygospor. 25 μ.

I. Lakes near Recess; Lakes, Clifden to Roundstone; Lough Aunierin (cum zygosp.).—II. Torc Mt.; Carrantuohill; Glen Caragh; Castletown.

††105. C. (Pleurotæniopsis) hibernicum, nov. sp. (Pl. XXI. fig. 19.)

C. (*Pleurotæniopsis*) magnum, diametro circiter duplo longius,

incisura mediana latissima et brevi; semicellulæ subrotundatæ, apicibus late rotundatis; a vertice visæ circulares; membrana lævis. Massa chlorophyllacea in laminis parietalibus dispositis irregulariter.

Long. 90 μ; lat. 45 μ.

I. Lakes, Clifden to Roundstone; Ballynahinch.

106. Cosmarium De-Baryi, *Arch.* [Pleurotænium cosmarioides, *De Bary* (*Rabh. Fl. Europ. Alg.* iii. p. 144).—Calocylindrus De-Baryi, *Cooke, Brit. Desm.* p. 128, tab. 44. fig. 4.]

I. Near Westport; Ballynahinch; Derryclare Lough.—II. Lough Guitane; near Lough Brin.

107. C. ovale, *Ralfs, Brit. Desm.* p. 98, tab. 15. fig. 9.

Long. 182–188 μ; lat. 100–107 μ; lat. isthm. 30–35 μ; crass. 75 μ.

I. Ballynahinch.—II. Adrigole.

108. C. elegantissimum, *Lund.* (*Desm. Suec.* p. 53, tab. 3. fig. 20.)

††Forma minor. (Pl. XXIV. fig. 10.)

Long. 50 μ; lat. 23 μ; lat. isthm. 19 μ.

II. Carrantuohill.

1. Xanthidium armatum, *Bréb. in Ralfs, Brit. Desm.* p. 112, tab. 18.

I. Ballynahinch; Kylemore; Oorid Lough; Arderry Lough; Lough Aunierin; near Oughterard; Lakes near Recess; Lakes, Clifden to Roundstone.—II. Glen Caragh; Adrigole; Glengarriff; Castletown; Carrantuohill.

†† Var. irregularius, nov. var. (Pl. XXII. fig. 1.)

Semicellulæ suboctangulares sinu aperto (nec lineari); processibus subirregularibus irregulariter dispositis, aliis ad spinas simplices curvatas reductis.

Long. sine proc. 160–165 μ; lat. sine proc. 95–107; lat. cum proc. 110–123 μ; lat. apic. 55–59 μ; lat. isthm. 41–50 μ.

I. Ballynahinch; Kylemore.

2. X. aculeatum, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 113, tab. 19. fig. 1.)

II. Lough Guitane.

3. Xanthidium fasciculatum, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 114, tab. 20. fig. 1.)

I. Derryclare Lough; Ballynahinch; Lakes near Recess.

4. X. antilopæum, *Kuetz.* (*Cooke, Brit. Desm.* p. 132, tab. 46. fig. 2.)

I. Creggan Lough; Ballynahinch (cum zygosp.); Lough Aunierin; Derryclare Lough; Baheh Loughs.—II. Muckross; Upper and Lower Lakes of Killarney; near Lough Brin; Adrigole; Glen Caragh; Castletown; Glengarriff.

An inchoate form of this was very frequently seen from Derryclare Lough, a figure of which is given (Pl. XXII. fig. 2). It differs from the type in having fewer spines, one semicell having but two spines, one on each inferior angle, the other semicell having four spines, two at each of the inferior angles, and one imperfect one at one of the superior angles; all the spines being less robust than normal, and arranged in the median plane of the lateral view. Compare with *X. inchoatum*, Nord. (Fr. Wat. Alg. of New Zeal. & Austr. p. 45, tab. 4. fig. 30).

Long. 47 μ; lat. sine spin.=long.; long. spin. 10 μ; lat. isthm. 12·5 μ; crass. 30 μ.

5. X. cristatum, *Bréb. in Ralfs, Brit. Desm.* p. 115, tab. 19. fig. 3.

I. Near Westport; Lough Aunierin; Ballynahinch; Creggan Lough; Lakes, Clifden to Roundstone; Derryclare Lough.—II. Muckross; Glengarriff.

††Forma angulatum. (Pl. XXII. fig. 3.)

Forma distincta angularis, spinis rectis ad angulos et membrana punctata.

Long. sine spin. 51 μ; lat. cum. spin. 62 μ; lat. sine spin. 40–43 μ; lat. apic. 22 μ; lat. isthm. 12·5 μ; crass. 22·5 μ.

I. Lough Aunierin.

Var. uncinatum, *Bréb. in Ralfs, Brit. Desm.* p. 115.

I. Ballynahinch.

Var. spinuliferum, *West.* (*Fr. Wat. Alg. of N. Wales,* p. 291, tab. 5. fig. 21.)

I. Lough Aunierin.

††6. XANTHIDIUM SUBHASTIFERUM, nov. sp. (Pl. XXII. fig. 4.)

X. tam longum quam latum, incisura mediana profunda acutangula aperta ; semicellulæ oblongo-ellipticæ, cum duo spinis singulis divergentibus ad utrumque latus ; a vertice visæ ellipticæ cum spina una exhibente ad apices ; a latere visæ rotundatæ ; membrana lævis in centro semicellularum incrassato.

Long. 54 μ ; lat. sine spin. 50 μ ; long. spin. 12·5–18 μ ; lat. isthm. 19 μ ; crass. 27 μ.

II. Lough Guitane ; Glen Caragh.

This is at once distinguished from all other species hitherto described as British in bearing but two spines on each lateral margin of each semicell, the central protuberance is also reduced to a strong thickening of the membrane. From *X. hastiferum*, Turn. (Some New and Rare Desm., in Journ. Royal Micr. Soc., Dec. 1885, p. 938, pl. 15. fig. 20), it differs in its non-angular semicells, larger size, and in being destitute of the small apical spines ; it differs from var. *inevolutum*, Nord. (Fr. Wat. Alg. of New Zeal. & Austr. p. 43, pl. 4. fig. 24), in its want of angularity, its larger size, and more elliptical end view.

7. X. SMITHII, *Arch.* (*Pritch. Infus.* ed. 1861, p. 736.)

I. Lakes, Clifden to Roundstone.—II. Cromagloun ; Torc Mt. ; Castletown.

††Var. COLLUM, nov. var. (Pl. XXII. fig. 5.)

Var. spinis tribus ad angulos superiores ; marginibus lateralibus et polis concavis, incisura lata et quadrata cum angulis incisuræ latæ et quadratæ rotundatis ; isthmo longo.

Long. sine spin. 30 μ ; lat. ad bas. semicell. sine spin. 25 μ ; lat. ad apic. sine spin. 20 μ ; long. spin. 5–7·5 μ ; lat. isthm. 9 μ ; crass. 15 μ.

II. Cromagloun.

This is not a stage of division.

†Var. VARIABILE, *Nord.* (*Fr. Wat. Alg. of New Zeal. & Austr.* p. 44, tab. 4. figs. 27–29.)

Long. sine spin. 22·5–25 μ ; long. cum spin. 23·5–27 μ ; lat. sine spin. 18–20 μ ; lat. cum spin. 22–23·5 μ ; lat. isthm. 7·5–8·5 μ ; crass. 12·5–14 μ.

I. Near Oughterard ; Clifden.—II. Cromagloun ; Carrantuohill ; Torc Mt.

††8. XANTHIDIUM APICULIFERUM, nov. sp. (Pl. XXIV. fig. 17.)

X. pusillum, tam longum quam latum, medio modice constrictum, sinu angusto extrorsum dilatato; semicellulæ trapezoido-pyramidatæ, apicibus late truncatis spinas binas breves medium gerentibus, angulis inferioribus subrotundatis spinam unam brevem gerentibus, angulis superioribus spinas binas breves gerentibus; a vertice visæ ellipticæ brevi spina ad unumquemque polum, medio utroque latere tumore pusillo; a latere visæ subcirculares.

Long. cum spin. 12·5 μ; long. sine spin. 11·5 μ; lat. cum spin. 12·5 μ; lat. sine spin. 12 μ; lat. isthm. 5 μ; crass. 6·5 μ.

I. Lakes near Recess.

9. X. CONCINNUM, *Arch.*, ††var. BOLDTIANA, nov. var. [Arthrodesmus hexagonus, *Boldt*, forma, *Boldt* (*Siber. Chloroph.* taf. 5. fig. 17).] (Pl. XXII. fig. 6.)

Boldt's figure of *A. hexagonus* (*l. c.* fig. 16) seems to agree exactly with the description of *X. concinnum*, Arch. (Journ. Dubl. Micr. Club, iv. 1880–85, p. 32). Boldt also has a form of his above-mentioned species (fig. 17); this form appears to be the same as the Irish plant, so I propose to name it after Boldt as a variety of Archer's species. This belongs to the genus *Xanthidium*, because the semicells have a distinct central protuberance.

I. Near Oughterard; Moher Lough.—II. Lower Lake of Killarney, near O'Sullivan's Cascade.

Specimens from Moher Lough:—

Long. 14 μ; lat. sine mucr. 12·5 μ; lat. cum mucr. 16 μ; lat. isthm. 4 μ; crass. 8 μ.

Specimens from near Oughterard:—

Long. 10 μ; lat. sine mucr. 10–11·5 μ; lat. cum mucr. 12·5–14 μ; lat. isthm. 4–5 μ; crass. 6·5 μ.

1. ARTHRODESMUS OCTOCORNIS, *Ehrenb.* (Xanthidium? octocorne, *Ralfs*, *Brit. Desm.* p. 116, tab. 20. fig. 2.)

Long. 18–21 μ; lat. sine spin. 15–16 μ; lat. cum spin. 28–30 μ; lat. isthm. 5–6 μ.

I. Ballynahinch; Roundstone; Lakes near Recess; Baheh Loughs; Lough Shannacloontippen; near Oughterard; Lough Aunierin; Creggan and Derryclare Loughs; Glendalough; Letereen Lough.—II. Cromagloun; Lough Guitane; Muckross;

Upper Lake of Killarney; near Lough Brin; Adrigole; Carrantuohill.

2. Arthrodesmus Incus, *Hass.* (*Ralfs, Brit. Desm.* p. 118, tab. 20. fig. 4 *a–d*, non *e–h*). (Pl. XXIV. fig. 11.)

Diam. zygosp. (sine spin.) 17 μ; diam. zygosp. (cum spin.) 27 μ.

I. Moher Lough; near Leenane; Derryclare; Shannacloontippen and Letereen Loughs; Lakes, Clifden to Roundstone and near Recess; Kylemore; Ballynahinch; Roundstone; near Westport; near Oughterard; Lakes E. of Lough Bofin.—II. Lough Guitane; Carrantuohill; Adrigole; near Lough Brin; Lower Lake of Killarney (cum zygosp.); Cromagloun; Muckross; Sugar Loaf Mt.

Forma apicibus constanter convexis.

Long. sine spin. 23–25 μ; lat. sine spin. 25–26 μ; lat. cum spin. 45–50 μ; long. spin. 13–17 μ; lat. isthm. 10–15 μ.

I. Ballynahinch.—II. Glengarriff.

†Var. intermedius, *Wittr.* (*Anteck. Skand. Desm.* p. 15, fig. 6.)

I. Athry Lough.

††3. A. Ralfsii, nov. sp.

[A. Incus, *Hass.*, *Ralfs, Brit. Desm.* tab. 20. fig. 4 *e–h*, nec *a–d*.]

A. mediocre; cellulæ diametro 1½plo longius (sine aculeis), modice constrictum, sinu lato et aperto; semicellulæ latissime campanulatæ, angulis inferioribus gibbosis, angulis superioribus spinis longis validis subinflexis adornatis, apicibus subconcavis; a verticæ visæ anguste ellipticæ, spina longa valida ad polum utrumque; membrana glabra.

I. Roundstone; Derryclare Lough.—II. Castletown; Adrigole; near Lough Brin.

This differs from *A. Incus*, Hass., in its somewhat larger size, its subquadrate semicells, its subconcave ends, its generally more open sinus, and its incurved spines.

†4. A. triangularis, *Lagerh.* (*Bidrag till Amerik. Desm. Fl.* p. 244, tab. 27. fig. 22.) Forma. (Pl. XXIV. fig. 19.)

I. Ballynahinch.

†Var. AMERICANUS, *nob.* [A. Incus, *Hass.*, var. americanus, *W. Turn.* (*Some new and rare Desm.*, in Journ. Roy. Micr. Soc., Dec. 1885, p. 937, pl. 16. fig. 17).]

Var. marginibus lateralibus convexioribus, a vertice visæ cellulis latioribus.

Long. 27 μ; lat. sine spin. 22·5 μ; lat. cum spin. 65 μ; long. spin. 22 μ; lat. isthm. 9 μ; crass. 11 μ.

I. Lakes, Clifden to Roundstone, and near Recess.

5. ARTHRODESMUS LONGICORNIS, *Roy* (*in lit. cum icone*).

Long. 23 μ; lat. cum spin. 62 μ; lat. isthm. 7·5 μ.

I. Derryclare Lough.

6. A. CONVERGENS, *Ehrenb.* (*Ralfs*, *Brit. Desm.* p. 118, tab. 20. fig. 3.)

I. Ballynahinch; Creggan Lough; Derryclare Lough; Clifden.—II. Clogerheen; Glen Caragh.

††7. A. ELEGANS, nov. sp. (Pl. XXII. fig. 7.)

A. mediocre, paulo longior quam latius (sine aculeis), profunde constrictus, sinu subrectangulari extremo obtuso; semicellulæ obverse semiorbiculares, marginibus lateralibus superioribus in spinis longis et subconvergentibus attenuatis, spinis binis brevibus delicatis truncato-bifurcatis intra margines laterales ornatæ, dorso convexo spinis 6–8 brevibus delicatis truncato-bifurcatis ornatæ; a vertice visæ ellipticæ, spinas breves longasque ostendentes; membrana glabra.

Long. sine proc. 30 μ; long cum proc. 38 μ; lat. sine spin. 27 μ; lat. cum spin. 65 μ; long. spin. 20–22 μ; lat. isthm. 10 μ; crass. sine proc. 13 μ; crass. cum proc. 25 μ.

I. Ballynahinch.

8. A. BIFIDUS, *Bréb.*, var. TRUNCATUS, *West.* (*Journ. Bot.* Oct. 1889, tab. 291. fig. 9.)

I. Ballynahinch; Lakes, Clifden to Roundstone; Derryclare Lough.

†† Var. LATODIVERGENS, nov. var. (Pl. XXII. fig. 8.)

A. minimus; tam longus quam latus, sinu late exciso; semicellulæ obverse triangulares, marginibus lateralibus subrectis apice recto, spinis duabus late divergentibus ad angulum unum unumquemque; a vertice visæ ellipticæ, spina una ad polum unumquemque; membrana glabra.

Long. cum spin. 18 μ; long. sine spin. 12·5 μ; lat. cum spin. 18 μ; lat. sine spin. 12·5 μ; crass. 6·5 μ.

I. Ballynahinch.

9. ARTHRODESMUS TENUISSIMUS, *Arch.* (*Rabh. Fl. Europ. Alg.* iii. p. 226.) (Pl. XXII. fig. 9.)

I. Ballynahinch; Lough Aunierin.

Specimens from Ballynahinch:—

Long. sine mucr. 8 μ; long. cum mucr. 9 μ; lat. cum spin. 19 μ; lat. sine spin. 9 μ; long. spin. 5 μ; lat. isthm. 5 μ.

Specimens from Lough Aunierin:—

Long. sine mucr. 12·5 μ; long. cum mucr. 14 μ; lat. cum spin. 32 μ; lat. sine spin. 12·5 μ; long. spin. 9·5–10 μ; lat. isthm. 3·5 μ; crass. 6 μ.

As we are unable to understand the figures representing vertical views of this species given in Cooke's Brit. Desmids, pl. 47. figs. 3 *d* & 3 *f*, we give a figure. Cooke's figures represent it as being 10·5–12·5 μ long; the dimensions given in the text are 8·5 μ long.

†10. A.? GLAUCESCENS, *Wittr.* (*Gotl. och Öl. Sötvat. Alg.* p. 55, tab. 4. fig. 11.)

I. Ballynahinch; Derryclare Lough; Creggan Lough.

††Forma CONVEXA. (Pl. XXII. fig. 10.)

F. paulo longior quam latum, minor apicibus convexis (nec retusis).

Long. 12 μ; lat. sine spin. 10 μ; lat. cum spin. 12·5 μ; lat. isthm. 5 μ; crass. 6·5 μ.

I. Creggan Lough.—II. Adrigole.

1. STAURASTRUM DEJECTUM, *Bréb.* (*Ralfs, Desm.* p. 121, tab. 20. fig. 5.)

I. Clifden; Creggan Lough; Lakes near Recess; near Westport; Lough Shannacloontippen; Oorid Lough; Derryclare Lough; Glendalough.—II. Lough Guitane; Glen Caragh; Castletown; Glengarriff; Lower Lake of Killarney; near Lough Brin; Adrigole.

††Var. INFLATUM, nov. var. (Pl. XXII. fig. 11.)

Var. multo major, semicellulis ellipticioribus et inflatis, spinis brevioribus (extrorsum versis).

Long. sine spin. 43 μ; lat. sine spin. 52 μ; lat. isthm. 12 μ.

I. Derryclare Lough; Ballynahinch.

2. Staurastrum connatum, *Roy et Biss.* (*Jap. Desm.* p. 237.)

Long. cum spin. 32–37 μ; long. sine spin. 21–22·5 μ; lat. cum spin. 25–28 μ; lat. isthm. 9–10 μ.

I. Athry Lake; near Oughterard; Ballynahinch; Lakes, Clifden to Roundstone.—II. Adrigole.

3. S. apiculatum, *Bréb.* (*Arch. in Pritch. Infus.* ed. 1861, p. 737.)

I. Ballynahinch; Kylemore; Roundstone; Lakes near Recess.—II. Carrantuohill; Lower Lake of Killarney; Clogerheen.

4. S. Dickiei, *Ralfs.* (*Brit. Desm.* p. 123, tab. 21. fig. 3.)

Long. 35 μ; lat. sine spin. 29 μ; lat. cum spin. 42 μ; lat. isthm. 6 μ.

I. Baheh Loughs; near Westport.—II. Lough Guitane; Cloonee Lough; Adrigole; near Lough Brin; Muckross; Glen Caragh.—Burren Hills, Co. Clare.

††Forma punctata.

Forma membrana minute punctata (nec granulata). (Vide var. *granulatum*, Roy et Biss. [Jap. Desm. p. 238].)

Long. 32 μ; lat. 33 μ; lat. isthm. 7 μ.

I. Clifden; near Westport; Ballynahinch.—II. Adrigole.

5. S. cuspidatum, *Bréb.* (*Ralfs, Brit. Desm.* p. 122, tab. 21. fig. 1.)

I. Near Westport; Athry Lake; Derryclare Lough; Nacoogarrow and Aunierin Loughs.—II. Lough Guitane.

†Var. divergens, *Nord.* (*Desm. Brasil.* tab. 4. fig. 49.)

Long. sine spin. 25 μ; lat. sine spin. 20–22 μ; long. spin. 10–12 μ; lat. isthm. 6 μ.

I. Ballynahinch; Glendalough.—II. Adrigole.

†6. S. corniculatum, *Lund.* (*Desm. Suec.* p. 57, tab. 3. fig. 23.)

††Var. spinigerum, nov. var. (Pl. XXII. fig. 12.)

Var. minor, spinis distinctis ad apices angulorum, et isthmo angustiore.

Long. (sine spin.) 28 μ; lat. 25 μ; lat. isthm. 11·5 μ.

I. Lakes, Clifden to Roundstone.

Compare with var. *variabile*, Nord. (Fr. Wat. Alg. of New Zeal. & Austr. p. 39, pl. 4. fig. 17).

†7. STAURASTRUM MINUTISSIMUM, *Reinsch*, ††var. CONSTRICTUM, nov. var. (Pl. XXIV. fig. 14.)

Var. major et profundius constricta quam forma typica; semicellulæ a vertice visæ trigonæ, lateribus subconcavis.

Long. 16 μ; lat. 17·5 μ; lat. isthm. 9 μ.

I. Clifden.

8. S. ARISTIFERUM, *Ralfs*. (*Brit. Desm.* p. 123, tab. 21. fig. 2.)

I. Derryclare Lough; Kylemore.

9. S. PTEROSPORUM, *Lund*. (*Desm. Suec.* p. 60, tab. 3. fig. 29.)

II. Adrigole.

10. S. O'MEARII, *Arch*. (*Pritch. Infus.* ed. 1861, p. 738.)

I. Athry Lough; Roundstone.—II. Castletown; Adrigole.

††Var. MINUTUM, nov. var. (Pl. XXII. fig. 15.)

S. minutum, brevius quam latius, minus quam forma typica, spinis longioribus, apicibus subconcavis; semicellulæ a vertice visæ angulis acutissimis.

Long. sine spin. 7–8 μ; lat. sine spin. 10 μ; long. spin. 10 μ; lat. isthm. 5 μ.

II. Cromagloun.

††11. S. CURVATUM, nov. sp. (Pl. XXII. fig. 13.)

S. mediocre, latius quam longius, profunde constrictum, sinu subrectangulari extremo obtuso; semicellulæ (extrorsum) lunatæ, dorso concavæ, utroque fine in aculeum longum gracilem divergentem attenuato; a vertice visæ triangulares, lateribus concavis, angulis in aculeum longum gracilem productis; membrana glabra.

Long. sine spin. 25 μ; lat. sine spin. 20 μ; long. spin. 20 μ; lat. isthm. 5–6 μ.

I. Derryclare Lough; Ballynahinch.—II. Lough Guitane.

This differs from *S. dejectum*, Bréb., and allied species in the form of the cells in both front and vertical views.

††12. S. JACULIFERUM, nov. sp. (Pl. XXII. fig. 14.)

S. parvum, circiter $1\frac{1}{2}$plo longius quam latius, profunde constrictum, sinu acutangulo et amplissimo; semicellulæ cuneatæ cum lateribus convexis et subconvexæ ad apices, angulis superioribus cum spinis validis longissimis divergentibus; a vertice visæ trigonæ, lateribus subconvexis et spina una ad utrumque angulum. Membrana lævis.

Long. sine acul. 27–30 μ; lat. sine acul. 17–20 μ; long. acul. 30–38 μ; lat. isthm. 7–7·5 μ.

II. Lough Guitane.

This is widely different from *Staurastrum aristiferum*, Ralfs, to which British species it nearest approaches, the convex sides of the end view and the different insertion of the spines being alone sufficient to distinguish it. From *S. Lewisii*, Wood, it differs in the absence of the small spines from the straight sides of the front view of the more triangular semicells.

13. Staurastrum megacanthum, *Lund.* (*Desm. Suec.* p. 61, tab. 4. fig. 1.)

I. Lakes, Clifden to Roundstone; Ballynahinch.

†14. S. bacillare, *Bréb. in Ralfs, Brit. Desm.* p. 214, tab. 35. fig. 21.

Long. 25 μ; lat. 33 μ; lat. isthm. 7 μ.

I. Lough Aunierin.

Var. obesum, *Lund.* (*Desm. Suec.* p. 57, tab. 3. fig. 24.)

II. Adrigole.

15. S. lunatum, *Ralfs.* (*Brit. Desm.* p. 124, tab. 34. fig. 12.)

Long. sine spin. 25 μ; lat. sine spin. 30 μ; lat. cum spin. 36 μ; lat. isthm. 12·5 μ.

I. Derryclare Lough; Oorid Lough.—II. Near Lough Brin.

16. S. cristatum, *Arch.* (*Pritch. Infus.* ed. 1861, p. 738.) (Pl. XXII. fig. 16.)

Long. 40 μ; lat. (cum spin.) 45–46 μ; lat. isthm. 22·5 μ.

I. Lakes, Clifden to Roundstone.—II. Glengarriff; Carrantuohill.

17. S. oligacanthum, *Bréb.*, ††var. incisum, nov. var. (Pl. XXII. fig. 17.)

Semicellulæ marginibus lateralibus inferioribus incisis; a verticæ visæ triangulatæ, lateribus leviter convexis.

Long. 39 μ; lat. 40 μ; lat. isthm. 22·5 μ.

I. Lakes, Clifden to Roundstone.

†18. S. megalonotum, *Nord.* (*Desm. Arct.* tab. 8. fig. 38), forma, *Nord.* (*Desm. Grönl.* p. 11, tab. 7. fig. 7 et 8). (Pl. XXIII. fig. 1.)

Forma processibus apice bifidioribus.
Long. 50 μ; lat. 46 μ; lat. isthm. 16 μ.
I. Nacoogarrow Lough.—II. Carrantuohill.

19. STAURASTRUM AVICULA, *Bréb. in Ralfs, Brit. Desm.* p. 140, tab. 23. fig. 11.

I. Lough Shannacloontippen; Clifden; Lakes E. of Lough Bofin.—II. Carrantuohill.

††Var. VERRUCOSUM, nov. var. (Pl. XXIII. fig. 2.)

Var. membrana distincte verrucosa.
Long. 22·5–26 μ; lat. 33–37 μ; lat. isthm. 10 μ.
I. Derryclare Lough; Lakes east of Lough Bofin.—II. Clogerheen; Adrigole.

St. subarcuatum, Wolle, probably belongs to this species, as he surmised it might do; if so, it will fall under this variety.

20. S. FURCATUM, *Bréb.* (*Rabh. Fl. Europ. Alg.* iii. p. 218.)

I. Near Westport; Ballynahinch; Kylemore.—II. Lough Guitane; near Lough Brin; Castletown; Carrantuohill.

Var. ARMIGERUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 218.)
[S. armigerum, *Bréb.*]

II. Adrigole; Lower Lake of Killarney.

21. S. MONTICULOSUM, *Bréb.* (*Ralfs, Brit. Desm.* p. 130, tab. 34. fig. 9.)

II. Carrantuohill.

22. S. REINSCHII, *Roy.*

Forma trigona.
I. Lakes, Clifden to Roundstone; Kylemore; Ballynahinch; Roundstone; Lakes near Recess; Oorid Lough; Creggan Lough.—II. Lough Guitane; Glen Caragh; Lower Lake of Killarney.

Forma tetragona.
II. Carrantuohill.

23. S. HIRSUTUM, *Bréb. in Ralfs, Brit. Desm.* p. 127, tab. 22. fig. 3.

I. Ballynahinch; Clifden; Lakes near Recess.—II. Carrantuohill; Adrigole; Lower Lake of Killarney; Castletown.

24. STAURASTRUM PILOSUM, *Arch. in Pritch. Infus.* ed. 1861, p. 739.

I. Lough Shannacloontippen; near Leenane; Ballynahinch Athry and Shindilla Loughs; near Westport.—II. Cromagloun; near Lough Brin; Castletown; Carrantuohill.

25. S. TELIFERUM, *Ralfs.* (*Brit. Desm.* p. 128, tab. 22. fig. 4.)

I. Near Westport; Ballynahinch; Athry Lough; Boy Lough; Lakes, Clifden to Roundstone; Roundstone; Lakes near Recess; Lough Aunierin; Creggan Lough; Lough Shannacloontippen; Oorid Lough; Lakes east of Lough Bofin.—II. Lough Guitane; Torc Mt.; Muckross; Upper and Lower Lakes of Killarney; Carrantuohill; Adrigole; near Lough Brin; Glengarriff; Castletown.

A zygospore of this species is figured (Pl. XXIV. fig. 5) which has six semicells attached, as if it had been produced by the conjugation of three cells instead of two.

††Forma OBTUSA. (Pl. XXIV. fig. 6.)

Forma spinis brevibus obtusisque.

Long. sine spin. 45 μ; long. cum spin. 50 μ; lat. sine spin. 39 μ; lat. cum spin. 45 μ; lat. isthm. 12·5 μ.

I. Lakes, Clifden to Roundstone.

†26. S. POLYTRICHUM, *Perty.* (*Rabh. Fl. Europ. Alg.* iii. p. 214.) (Pl. XXII. fig. 18.)

Long. sine spin. 59–67 μ; long. cum spin. 70–80 μ; lat. sine spin. 45–58 μ; lat. cum spin. 56–70 μ; lat. isthm. 17–21.

I. Lakes, Clifden to Roundstone.—II. Cloonee Lough.

27. S. SPONGIOSUM, *Bréb.* (*Ralfs, Brit. Desm.* p. 141, tab. 23. fig. 4.)

II. Adrigole; Carrantuohill.

††Var. PERBIFIDUM, nov. var. (Pl. XXIII. fig. 3.)

Var. spinis longioribus et profunde furcatis.

Long. sine spin. 42 μ; long. cum spin. 52 μ; lat. sine spin. 38 μ; lat. cum spin. 52 μ; lat. isthm. 15 μ.

I. Near Westport.

28. S. ASPERUM, *Bréb. in Ralfs, Brit. Desm.* p. 139, tab. 22. fig. 6-

I. Near Oughterard; Ballynahinch.—II. Carrantuohill.

29. STAURASTRUM MAAMENSE, *Arch.* (*Cooke, Brit. Desm.* p. 155.) [S. pseudocrenatum, *Lund, Desm. Suec.* p. 65, tab. 4. fig. 4.]

Long. 32·5–42·5 μ; lat. 28–37·5 μ; lat. isthm. 10–13·5 μ.

I. Ballynahinch; Derryclare Lough.—II. Adrigole.

††30. S. TRACHYNOTUM, nov. sp. (S. saxonicum, *Reinsch*, 1867.)

††Var. ANNULATUM, nov. var. (Pl. XXIV. fig. 16.)

Var. cum annulo uno granulorum magnorum ad basin semicellulæ.

Long. cum spin. 48 μ; lat. cum spin. 40 μ; lat. sine spin. 35 μ; lat. isthm. 14 μ.

II. Carrantuohill.

As the specific name *saxonicum* was applied to a *Staurastrum* by Bulnheim in 1863, another name is needed for this species.

†31. S. SUBSCABRUM, *Nord.* (*Alg. Sandv.* p. 16, tab. 2. fig. 1.)

††Forma SCABRIOR. (Pl. XXIII. fig. 4.)

Forma membrana asperiore, præsertim ad apices.

Long. 40 μ; lat. 35–37 μ; lat. isthm. 10 μ.

I. Kylemore; Clifden.

††32. S. TRACHYGONUM, nov. sp. (Pl. XXIII. fig. 5.)

S. parvum, paulo longius quam latius, modice constrictum, sinu subaperto; semicellulæ subellipticæ apice truncatæ, spinis brevibus ad angulos apicesque præditæ (nonnullis truncatis); a vertice visæ triangulatæ, lateribus subconcavis, angulis rotundatis cum annulo spinarum brevium circa centrum glabrum.

Long. 32·5 μ; lat. 28 μ; lat. isthm. 7·5 μ.

I. Kylemore.

33. S. MUTICUM, *Bréb.* (*Ralfs, Brit. Desm.* p. 125, tab. 21. fig. 4, tab. 34. fig. 13.)

II. Lough Guitane; Adrigole.

34. S. ORBICULARE, *Ralfs.* (*Brit. Desm.* p. 125, tab. 21. fig. 5.)

Long. 37–41 μ; lat. 28–37 μ; lat. isthm. 7·5–11 μ.

I. Creggan Lough; Ballynahinch; Derryclare Lough; Lough Shindilla; Nacoogarrow Lough; Letereen Lough.—II. Lough Guitane; Lower Lake of Killarney; Glen Caragh; Carrantuohill; Adrigole; Castletown.

†Var. DEPRESSUM, *Roy et Biss.* (*Jap. Desm.* p. 237, tab. 268. fig. 14.)

Long. 27 μ; lat. 27 μ; lat. isthm. 7·5 μ.

I. Nacoogarrow Lough.—II. Lower Lake of Killarney; Carrantuohill; Sugar Loaf Mt.

†35. STAURASTRUM BIENEANUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 200.)

II. Adrigole.

†Var. ELLIPTICUM, *Wille.* (*Ferskv. Alg. fr. Nov. Seml.* p. 50, tab. 13. fig. 49.)

I. Derryclare, Shannacloontippen, and Nacoogarrow Loughs; near Westport.—II. Near Lough Brin; Adrigole; Glengarriff.

††36. S. HIBERNICUM, nov. sp. (Pl. XXIII. fig. 6.)

S. mediocre, fere quarta parte longius quam latius, profunde constrictum, sinu lineari et angusto; semicellulæ subtrapezicæ, angulis rotundatis; a vertice visæ triangulatæ, lateribus rectis, angulis late rotundatis; membrana lævis.

Long. 65 μ; lat. 52 μ; lat. isthm. 18 μ.

I. Near Westport.

This differs from *S. orbiculare*, Ralfs, in its much larger size, its flattened apex, and in the straight sides of the vertical view; from *S. globosum*, Roy et Biss. (Jap. Desm. p. 237, tab. 268. fig. 8), in its different sinus, apex, and membrane.

37. S. KJELLMANNI, *Wille.* (*Ferskv. Alg. fr. Nov. Seml.* p. 50, tab. 13. figs. 50–53.)

II. Glengarriff; Carrantuohill.

38. S. PYGMÆUM, *Bréb. in Ralfs, Brit. Desm.* p. 213, tab. 35. fig. 26.

I. Arderry Lough; Lough Aunierin; Clifden; Lakes near Recess; Oorid Lough; Nacoogarrow Lough.—II. Carrantuohill; Adrigole; near Lough Brin; Mallow.

††Var. TRILINEATUM, nov. var. (Pl. XXIII. fig. 7.)

Semicellulæ a fronte visæ scabriores quam forma typica, apice extremo truncatæ; a vertice visæ triangulares, angulis rotundatis et lateribus subrectis, serie subcurvata una granulorum majorum intra marginem subrectum unumquemque. Hæc var. major quam forma typica est.

Long. 48 μ; lat. 40 μ; lat. isthm. 15 μ.

I. Nacoogarrow Lough.

This variety was as rough (if not rougher) than forma *major*, Wille (Ferskv. fr. Nov. Seml. p. 51, tab. 13. fig. 54). Rabenhorst (Flor. Europ. Alg. iii. p. 220) expresses doubt as to whether the membrane is smooth or not; Brébisson, in Ralfs, Brit. Desm. p. 213, is silent on the matter. I always find this species to be very slightly granulate.

††39. STAURASTRUM SUBPYGMÆUM, nov. sp. (Pl. XXIII. fig. 8.)

S. mediocre, circiter tam longum quam latum, profunde constrictum, sinu subrectangulari extremo obtuso; semicellulæ latissime cuneatæ, ambitu glabræ, dorso subconvexæ, marginibus lateralibus leviter convexis, angulis submamillatis; a vertice visæ triangulares, lateribus subconvexis, angulis submamillatis; membrana delicate punctata.

Long. 42–45 μ; lat. 43 μ; lat. isthm. 16 μ.

I. Lough Aunierin.

Compare with *S. pygmæum*, Bréb., especially "forma" in Racib. Nonn. Desm. Polon. p. 31, tab. 3. fig. 12.

40. S. TURGESCENS, *De Not.* [S. punctulatum, *Bréb.*, var. turgescens (*De Not.*), *Rabh. Fl. Europ. Alg.* iii. p. 208.]

II. Cloonee Lough.

41. S. LANCEOLATUM, *Arch.* (*Rabh. Fl. Europ. Alg.* iii. p. 202.)

II. Adrigole.

42. S. INCONSPICUUM, *Nord.* (*Norges Desm.* p. 26, tab. 1. fig. 11.)

Long. cum proc. 15–17 μ; long. sine proc. 10–11 μ; lat. cum proc. 11–12·5 μ; lat. isthm. 5·5–6·5 μ.

I. Ballynahinch; Roundstone; Lakes, Clifden to Roundstone.—II. Upper and Lower Lakes of Killarney; Glengarriff; Adrigole; Castletown.

43. S. STRIOLATUM, *Arch.* (*Pritch. Infus.* ed. 1861, p. 740.)

Long. 22·5 μ; lat. 19–21 μ; lat. isthm. 10 μ.

I. Near Leenane; Roundstone; near Westport; Ballynahinch.

44. S. MURICATUM, *Bréb.* (*Ralfs, Brit. Desm.* p. 126, tab. 22. fig. 2.)

I. Lough Shannacloontippen; near Leenane; Creggan Lough; Lakes near Recess; Ballynahinch.—II. Carrantuohill; Cloonee Lough; near Lough Brin; Lower Lake of Killarney.

††45. STAURASTRUM PYRAMIDATUM, nov. sp. [S. muricatum, *Bréb.*, var. acutum, *West* (*Freshw. Alg. of N. Wales*, p. 294, tab. 5. fig. 14).]

S. mediocre, quinta parte longius quam latius, sinu lineari; semicellulæ pyramidato-truncatæ, marginibus lateralibus leviter convexis, apicibus truncatis et rectis vel levissime retusis; a vertice visæ triangulares, lateribus convexis, angulis late rotundatis; membrana spinis acutis irregulariter dispositis vestita.

Long. cum spin. 68 μ; long. sine spin. 60 μ; lat. cum spin. 55 μ; lat. sine spin. 50 μ; lat. isthm. 20 μ.

II. Carrantuohill.

46. S. PUNCTULATUM, *Bréb. in Ralfs, Brit. Desm.* p. 133, tab. 22. fig. 1.

I. Near Westport; Baheh Loughs; near Leenane; Lakes, Clifden to Roundstone; Ballynahinch; Lough Aunierin; Lakes near Recess; Lough Shannacloontippen.—II. Lower Lake of Killarney; Carrantuohill; Clogerheen.

47. S AMŒNUM, *Hilse.* [S. capitulum, *Bréb.*, var. amœnum, *Rabh. Fl. Europ. Alg.* iii. p. 209.]

I. Kylemore.—II. Lower Lake of Killarney; Carrantuohill.

†Var. BRASILIENSE, *Boerg.* (*Desm. Brasil.* p. 950, tab. 4. fig. 44.) (Pl. XXIII. fig. 9.)

Forma seriebus duabus transversis granulorum ad basin semicellularum; a vertice visa trigona, lateribus concavis; a basi visa margine 20-crenata.

Long. 38 μ; lat. ad bas. semicell. 20 μ; lat. ad apic. 22 μ; lat. isthm. 13 μ.

I. Ballynahinch.

48. S. MERIANI, *Reinsch.* (*Alg. Fl.* p. 160, tab. 12. fig. 1.)

Long. 40 μ; lat. ad bas. semicell. 20 μ; lat. ad apic. 25 μ; lat. isthm. 14 μ.

I. Derryclare Lough.—II. Carrantuohill; 8 miles S. of Kenmare.

49. Staurastrum alternans, *Bréb. in Ralfs, Brit. Desm.* p. 132, tab. 21. fig. 7.

Long. 22 μ; lat. 21 μ; lat. isthm. 7·5 μ.

I. Moher Lough; Derryclare Lough; Lakes near Recess, and from Clifden to Roundstone; Lakes east of Lough Bofin; Nacoogarrow Lough; Clifden.—II. Lower Lake of Killarney; Glengarriff.

50. S. dilatatum, *Ehrenb.* (*Ralfs, Brit. Desm.* p. 133, tab. 21. fig. 8.)

I. Creggan Lough.—II. Upper Lake of Killarney; Cloonee Lough.

†Var. obtusilobum, *De Not.* (*Nord. Fr. Wat. Alg. of New Zeal. & Austral.* p. 41, tab. 4. fig. 19.)

I. Lakes near Recess; Ballynahinch.

51. S. longispinum, *Arch.* (*Pritch. Infus.* ed. 1861, p. 743.)

Long. 97 μ; lat. sine spin. 87 μ; lat. cum spin. 130–135 μ; lat. isthm. 40 μ.

I. Lough Aunierin.—II. Adrigole.

52. S. tumidum, *Bréb. in Ralfs, Desm.* p. 126, tab. 21. fig. 6.

I. Near Westport.—II. Carrantuohill.

53. S. brachiatum, *Ralfs.* (*Brit. Desm.* p. 131, tab. 23. fig. 9.)

I. Kylemore; Derryclare Lough.—II. Castletown.

54. S. tricorne, *Menegh.* (*Ralfs, Brit. Desm.* p. 134, tab. 22. fig. 11.)

I. Baheh Loughs.—II. Lough Guitane; Mallow; Cloonee Lough; Lower Lake of Killarney; Carrantuohill.

Var. β, *Ralfs.* (*Ralfs, Brit. Desm.* p. 134, tab. 34. fig. 8, *b–d.*)

I. Ballynahinch; Lakes, Clifden to Roundstone.—II. Muckross; Adrigole.

†Var. semicirculare (*nob.*). [S. hexacerum, *Wittr.*, var. semicirculare, *Wittr.* (*Gotl. och Ol. Sötv. Alg.* p. 52, tab. 4. fig. 9).]

I. Derryclare Lough.

55. Staurastrum haaboeliense, *Wille.* (*Bidrag til Kunds. om Norges Ferskv. Alg.* p. 42, tab. 2. fig. 27.)

I. Ballynahinch.

56. S. cyrtocerum, *Bréb. in Ralfs, Brit. Desm.* p. 139, tab. 22. fig. 10.

Forma trigona.

I. Ballynahinch; Derryclare Lough; Lough Shindilla.—II. Clogerheen.

Forma tetragona.

II. Muckross; Adrigole.

57. S. arcuatum, *Nord.* (*Norges Desm.* p. 36, tab. 1. fig. 18.)

I. Lakes E. of Lough Bofin.—II. Near Lough Brin.

††Var. guitanense, nov. var. (Pl. XXIII. fig. 10.)

A forma typica differt isthmo latiore, processibus brevioribus cum delicatioribus spinis ad apices processuum, prominentiis brevioribus bifidis, longitudine relative majore.

Long. sine spin. 25 μ; lat. cum spin. 40 μ; lat. isthm. 14 μ.

II. Lough Guitane.

58. S. inflexum, *Arch.* (*Pritch. Infus.* ed. 1861, p. 742.)

I. Moher Lough; Nacoogarrow Lough; Ballynahinch; Clifden.—II. Lough Guitane; Lower Lake of Killarney.

59. S. polymorphum, *Bréb. in Ralfs, Brit. Desm.* p. 135, tab. 22. fig. 9, tab. 34. fig. 6.

Forma trigona.

I. Lakes near Recess; Ballynahinch; Lough Shannacloontippen.—II. Kenmare; Adrigole.

Forma tetragona.

I. Near Westport; Derryclare Lough; Moher Lough; Ballynahinch.—II. Lough Guitane; Upper Lake of Killarney; Kenmare.

Forma pentagona.

I. Derryclare Lough.—II. Carrantuohill; near Lough Brin.

†Var. subgracile, *Wittr.* (*Om Gotl. och Ol. Sötv. Alg.* p. 51.) [S. crenulatum, *Naeg.*]

Forma pentagona.

I. Derryclare Lough; Lakes E. of Lough Bofin.

60. S. gracile, *Ralfs.* (*Brit. Desm.* p. 136, tab. 22. fig. 12.)

Forma trigona.

I. Near Westport; Athry Lough; Ballynahinch; Glendalough; Shindilla and Boy Loughs; Nabincka Lough.—II. Lough Guitane; Upper Lake of Killarney; near Lough Brin; Adrigole; Cloonee Lough; Carrantuohill.

Var. NANUM, *Wille*. (*Bidrag til Kundsk. om Norges Ferskv.* p. 46, tab. 2. fig. 31.)

Forma trigona apicibus truncatis.

Long. 25 μ; lat. 35 μ; lat. isthm. 6 μ.

II. Upper Lake of Killarney.

Forma tetragona.

I. Nacoogarrow Lough; Lough Aunierin.—II. Adrigole.

††*BULBOSUM, nov. subsp. (Pl. XXIII. fig. 11.)

S. magnum, $1\frac{1}{2}$–2plo latius quam longius (cum processibus), modice constrictum, sinu acuto; semicellulæ gracile campanulatæ; e base turgido, angulis superioribus in processibus longis denticulatis cum apicibus bifidis attenuatis; a vertice visæ triradiatæ, serie granulorum parvorum intra marginem.

Long. 52 μ; lat. cum proc. 95 μ; lat. max. prope bas. semicell. 18 μ; lat. isthm. 11 μ.

I. Derryclare Lough.

61. STAURASTRUM PARADOXUM, *Meyen*. (*Ralfs, Brit. Desm.* p. 138, tab. 23. fig. 8.)

I. Lakes near Recess; Athry and Nabincka Loughs; Roundstone; Lakes, Clifden to Roundstone; Lakes east of Lough Bofin; Ballynahinch.—II. Torc Mt.

††Forma PARVA. (Pl. XXIII. fig. 12.)

Long. cum proc. 35 μ; long. sine proc. 16 μ; lat. cum proc. 28 μ; lat. isthm. 6 μ.

I. Ballynahinch.—II. Adrigole.

Var. LONGIPES, *Nord.* (*Norges Desm.* p. 35, tab. 1. fig. 17.)

I. Arderry Lough; Lough Aunierin; Derryclare Lough.—II. Torc Mt.; Cromagloun; Sugar Loaf Mt.; Cloonee Lough.

††Var. NODULOSUM, nov. var. (Pl. XXIII. fig. 13.)

Var. minor apicibus processuum leviter trifurcatis; semicellulæ a vertice visæ triangulares, lateribus binodulosis.

Long. cum proc. 33 μ; long. sine proc. 14 μ; lat. cum proc. 27·5–30 μ; lat. isthm. 5 μ.

II. Upper Lake of Killarney.

†62. Staurastrum contortum, *Delp.*, var. pseudotetracerum, *Nord.* (*Fr. Wat. Alg. of New Zeal. & Austr.* p. 37, tab. 4. fig. 9.)

I. Lakes near Recess.

††63. S. natator, nov. sp. (Pl. XXIII. fig. 14.)

S. mediocre, circiter duabus partibus longius quam latius, modice constrictum; incisura parva et aperta; semicellulæ subquadrangulares, marginibus lateralibus leviter crenatis, verrucis mucronatis magnis tribus ad polos; angulis superioribus productis in processibus denticulatis divergentibus, apice tridentatis; a vertice visæ ellipticæ, processibus productis ad polos; projectione prominente truncata centrali in medio, seriebus duabus verrucarum subquadratarum intra marginem ordinatis; a latere visæ subrotundæ projectione mediana, processu conspecto inter verrucas binas.

Long. sine proc. 38·5 μ; long. cum proc. 67 μ; lat. ad bas. semicell. 20 μ; lat. apic. sine proc. 25 μ; lat. cum proc. 75 μ; long. proc. 30–32·5 μ; lat. isthm. 12·5 μ; crass. 21·5 μ.

I. Derryclare Lough.

Compare with *S. brachioprominens*, Boerg. (Desm. Brasil. p. 952, tab. 5. fig. 52), and *S. paradoxum*, Meyen, var. *fusiforme*, Boldt. (Siber. Chloroph. p. 118, tab. 6. fig. 37).

††64. S. Archerii, nov. sp. (Pl. XXIII. fig. 15.)

S. magnum, subduplo longius quam latius (sine processibus), emarginatum ad medium; semicellulæ breviter cuneatæ, apice convexo glabratoque, marginibus lateralibus subrectis, angulis superioribus in processibus longissimis gracilibus radiatis denticulis productis, subcurvatis extrorsum, apicibus tridentatis; a vertice conspectæ circulares, processibus radiatis denticulatis, apicibus tridentatis; membrana glabra.

Long. (sine proc.) 69–78 μ; lat. cum proc. 130–140 μ; lat. sine proc. 43–48 μ; max. long. proc. 50 μ; lat. isthm. 24 μ.

I. Ballynahinch; Derryclare Lough.

The vertical view of this species is similar to that of *St. verticillatum*, Arch. (of which I have authentic figures), but the front view is quite different.

Named in honour of Wm. Archer, the illustrious pioneer of freshwater Algal work in Ireland.

65. Staurastrum controversum, *Bréb.* (*Ralfs, Brit. Desm.* p. 141, tab. 23. fig. 3.)

II. Sugar Loaf Mt.; Adrigole; Castletown.

66. S. aculeatum, *Menegh.*, †*cosmospinosum, *Boerg.* (*Bidrag til Bornh. Desm.-Flora*, p. 147, tab. 6. fig. 8).

II. Carrantuohill.

67. S. vestitum, *Ralfs.* (*Brit. Desm.* p. 143, tab. 23. fig. 1.)

I. Ballynahinch; Arderry Lough; near Westport.—II. Upper Lake of Killarney; Adrigole; Glengarriff.

68. S. oxyacanthum, *Arch. in Pritch. Infusoria*, ed. 1861, p. 742.

Long. cum spin. 33–35 μ; long. sine spin. 28–29 μ; lat. cum proc. 42–43 μ; lat. isthm. 10–12 μ.

I. Ballynahinch; Lakes, Clifden to Roundstone, and near Recess; Derryclare Lough.—II. Cromagloun; Glengarriff; Adrigole.

69. S. Sebaldi, *Reinsch.* (*Alg. Fl.* p. 175, tab. 11. fig. 1.)

Forma trigona.

I. Near Oughterard.

Forma tetragona.

II. Carrantuohill.

Var. ornatum, *Nord.* (*Norges Desm.* p. 34, tab. 1. fig. 15.)

I. Near Westport; Derryclare Lough; Arderry Lough.

†70. S. Pseudosebaldi, *Wille.* (*Bidrag til Kunds. om Norges Ferskv. Alg.* p. 45, tab. 2. fig. 30.) ††*duacense, nov. subsp. (Pl. XXIV. fig. 1.)

S. mediocre, subduplo latius quam longius; semicellulæ ob-cuneatæ ad basin non inflatæ, apicibus verrucis bifurcatis præditæ, angulis superioribus productis in radium denticulatum rectum bifidum ad apicem, cum verruca insigni ad basin interiorem radii; a vertice visæ biradiatæ ad centrum multum inflatæ, glabræ, apicibus exhibentibus spinam unam.

Long. 32–35 μ; lat. 55–60 μ; lat. isthm. 11 μ; crass. in med. 18 μ.

I. Ballynahinch; Roundstone.

This subspecies differs from *Staurastrum Pseudosebaldi*, Wille, var. *bicorne*, Boldt. (Siber. Chloroph. tab. 6. fig. 36), in the straighter processes of the end view, and in the presence of the warts at the base of the bifurcate processes. It differs from *S. Pseudosebaldi*, Wille, **tonsum*, Nord. (Fr. Wat. Alg. of New Zeal. & Austr. p. 36, tab. 4. fig. 4), in the non-fusiform shape of the end view as well as in the not reduced apical warts.

†71. STAURASTRUM MANFELDTII, *Delp.* (*Desm. Subalp.* p. 160, tab. 13. fig. 12.)

Long. 46 μ; lat. cum proc. 77 μ; lat. isthm. 10 μ.

I. Ballynahinch.

72. S. ANATINUM, *Cooke et Wills.* (*Grevillea*, 1880, p. 92, tab. 139. fig. 6.)

Long. 55 μ; lat. (cum proc.) 75–85 μ; lat. isthm. 18 μ.

I. Ballynahinch; Arderry Lough; Lakes east of Lough Bofin; Oorid Lough; Lakes, Clifden to Roundstone.—II. Upper Lake of Killarney; Glen Caragh; Adrigole; Sugar Loaf Mt.; 8 miles S. of Kenmare.

††Var. TRUNCATUM, nov. var. (Pl. XXIV. fig. 2.)

Var. cum apicibus semicellularum truncatis et verrucis minoribus; angulis contractis ad bases radiorum.

Long. 58–65 μ; lat. cum proc. 95–100 μ; lat. isthm. 18–20 μ.

II. Lough Guitane.

††* BIRADIATUM, nov. subsp. (Pl. XXIV. fig. 3.)

S. submagnum, duplo latius quam longius (cum processibus), profunde constrictum, sinu sublineari; semicellulæ obverse elliptico-semicirculares, lateribus subverrucosis, angulis (superioribus) in processibus robustis rectis granulatis productis, apice trifidis, dorso levissime convexo, verrucis numerosis emarginato-bifidis, serie verrucarum similarum intra marginem; a vertice visæ fusiformes, utrinque verrucis numerosis emarginato-bifidis instructis, serie una verrucarum similarum intra marginem unumquemque, processibus granulatis apicibus trifurcatis.

Long. 40 μ; lat. cum proc. 82 μ; lat. isthm. 8 μ; crass. 23 μ.

I. Lakes near Recess.

73. S. EUSTEPHANUM, *Ralfs.* (*Brit. Desm.* p. 215.)

I. Lakes, Clifden to Roundstone; Ballynahinch.—II. Glen Caragh.

74. Staurastrum furcigerum, *Bréb.* [Didymocladum furcigerum (*Bréb.*), *Ralfs, Brit. Desm.* p. 144, tab. 33. fig. 12.]

Long. cum proc. 60–75 μ; long. sine proc. 37·5–40 μ; lat. cum proc. 50–67 μ; lat. isthm. 14–16 μ.

I. Lakes near Recess; Arderry and Creggan Loughs; Ballynahinch.—II. Glen Caragh.

75. S. Arctiscon, *Lund.* (*Desm. Suec.* p. 70, tab. 4. fig. 8.)

I. Lakes east of Lough Bofin.

76. S. læve, *Ralfs.* (*Brit. Desm.* p. 131, tab. 23. fig. 10.)

II. Adrigole.

77. S. sexcostatum, *Bréb.* (*Ralfs, Brit. Desm.* p. 129, tab. 23. fig. 5.)

II. Lough Guitane; Adrigole.

78. S. margaritaceum, *Menegh.* (*Ralfs, Brit. Desm.* p. 134, tab. 21. fig. 9.)

Forma tetragona.

I. Near Westport; Roundstone; Kylemore; Oorid Lough; near Oughterard; Lakes, Clifden to Roundstone and near Recess.—II. Lough Guitane; Cromagloun; Lower Lake of Killarney; Glen Caragh; Carrantuohill; Castletown.

Forma pentagona.

I. Kylemore; Ballynahinch; Lakes, Clifden to Roundstone. —II. Carrantuohill; Sugar Loaf Mt.; Lower Lake of Killarney; Glen Caragh.

Forma hexagona.

I. Kylemore.

†Var. hirtum, *Nord.* (*De Alg. et Char.* i. p. 11, tab. 16. fig. 18.)

II. Castletown; Carrantuohill.

††79. S. arachnoides, nov. sp. (Pl. XXIV. fig. 4.)

S. mediocre, modice constrictum, sinu lato et obtuso; semicellulæ late campanulatæ, apicibus truncatis granulis emarginatis præditis, processibus longis gracillimis denticulatis leviter incurvatis ad angulos superiores, apicibus tridenticulatis; a vertice visæ annulo granulorum novem intra marginem, pentaradiatæ, processibus longis attenuatis subflexis.

Long. 37 μ; lat. cum proc. 67–71 μ; lat. sine proc. 20 μ; long. proc. 25–27 μ; lat. isthm. 9 μ.

I. Lakes, Clifden to Roundstone.

80. Staurastrum arachne, *Ralfs.* (*Brit. Desm.* p. 136, tab. 23. fig. 6.)

Long. 2 μ; lat. cum. proc. 48–52 μ; lat. sine proc. 17·5–20 μ; lat. isthm. 9 μ.

I. Derryclare Lough; Lakes, Clifden to Roundstone; Ballynahinch; Athry Lough.—II. Adrigole.

81. S. tetracerum, *Ralfs.* (*Brit. Desm.* p. 137, tab. 23. fig. 7.)

I. Near Westport; Ballynahinch; Lakes, Clifden to Roundstone; Athry Lough; Derryclare Lough; Lough Aunierin; near Oughterard; Lough Shannacloontippen; Roundstone; Lakes near Recess; Letereen Lough.—II. Lough Guitane; Cromagloun; Torc Mt.; Muckross; Glengarriff; Upper and Lower Lakes of Killarney; near Lough Brin; Adrigole; Castletown.

†Forma trigona, *Lund.* (*Desm. Suec.* p. 69.)

Long. sine proc. 11 μ; long. cum proc. 32 μ; lat. cum proc. 30 μ; lat. isthm. 5·5 μ.

I. Athry Lough; Lakes, Clifden to Roundstone; Ballynahinch; near Westport.—II. Muckross; Clogerheen; Glen Caragh; Glengarriff; near Lough Brin.

Class Cœnobieæ.

Ord. Volvocineæ.

1. Eudorina elegans, *Ehrenb.* (*Rabh. Fl. Europ. Alg.* iii. p. 98.)

I. Lakes, Clifden to Roundstone.

Ord. Pandorineæ.

1. Pandorina morum, *Ehrenb.* (*Rabh. l. c.* p. 99, fig. 49.)

I. Near Westport; Baheh Loughs.—II. Upper Lake of Killarney.

1. Gonium pectorale, *Muell.* (*Rabh. l. c.* p. 99.)

I. Moher Lough.—II. Upper Lake of Killarney.

Ord. PEDIASTREÆ.

1. PEDIASTRUM ANGULOSUM, *Ehrnb.* (*Ralfs, Brit. Desm.* p. 187, tab. 31. fig. 11.)

I. Nacoogarrow Lough; Shindilla Lough.

2. P. BORYANUM, *Menegh.* (*Ralfs, Brit. Desm.* p. 187, tab. 31. fig. 9.)

I. Near Westport; Ballynahinch.—II. Lough Guitane; Clogerheen; Kenmare; Mallow.

Var. GRANULATUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 75.)

I. Near Westport; Lakes, Clifden to Roundstone; Creggan Lough.—II. Lower Lake of Killarney.

3. P. BIDENTULUM, *A. Br.* (*Rabh. Fl. Europ. Alg.* iii. p. 77.)

I. Lough Shannacloontippen; Baheh Loughs.

4. P. CONSTRICTUM, *Hass.* [P. ellipticum, *Ralfs, Brit. Desm.* p. 188, tab. 31. fig. 10.]

II. Lower Lake of Killarney.

5. P. PERTUSUM, *Kuetz.* (*Ralfs, Brit. Desm.* p. 185, tab. 31. fig. 6 *d.*)

I. Moher Lough; Derryclare and Creggan Loughs; Lough Shannacloontippen.—II. Upper and Lower Lakes of Killarney.

6. P. TETRAS, *Ralfs.* [P. Ehrenbergii, *A. Br.*]

Forma *a.* Dispositio cellularum 4.

I. Lakes, Clifden to Roundstone; Clifden; Derryclare Lough; Lough Aunierin; Lough Shannacloontippen.—II. Lough Guitane; Upper and Lower Lakes of Killarney; near Lough Brin; Glengarriff; Cloonee Lough; Mallow.

Forma *c.* Dispositio cellularum 1+7.

I. Derryclare, Baheh, and Shindilla Loughs; Lough Shannacloontippen; Clifden; Lakes E. of Lough Bofin.—II. Glen Caragh; Adrigole; near Lough Brin.

Forma *d.* Dispositio cellularum 5+11.

II. Glen Caragh.

7. P. INTEGRUM, *Naeg.* (*Rabh. Fl. Europ. Alg.* iii. p. 71.)

II. Lower Lake of Killarney.

Ord. SORASTREÆ.

1. SELENASTRUM BIBRAIANUM, *Reinsch*. (*Alg. Fl.* p. 64.)
I. Near Oughterard.

1. SORASTRUM SPINULOSUM, *Naeg.* (*Rabh. Fl. Europ. Alg.* iii. p. 81.)
I. Lough Aunierin; Derryclare Lough; Ballynahinch.—II. Lough Guitane; Kenmare.

†1. STAUROGENIA HETEROCANTHA, *Nord. in Wittr. et Nord. Alg. Exsic.* no. 451.
I. Derryclare Lough.

2. S. RECTANGULARIS, *A. Br.* (*Rabh. Fl. Europ. Alg.* iii. p. 80.)
I. Lough Shannacloontippen; Clifden.—II. Kenmare; Lower Lake of Killarney; Castletown.

1. CŒLASTRUM SPHÆRICUM, *Naeg.* [C. Nägelii, *Rabh. Fl. Europ. Alg.* iii. p. 79, pro parte.]
I. Near Westport.

2. C. CAMBRICUM, *Arch.* (*Cooke, Brit. Fr. Wat. Alg.* p. 46; *Wolle, Fr. Wat. Alg. U. S.* p. 170, tab. 156. fig. 5.)
I. Loughs Shannacloontippen and Aunierin.—II. Glengarriff.

3. C. CUBICUM, *Naeg.* [C. Nägelii, *Rabh. Fl. Europ. Alg.* iii. p. 79, pro parte.]
I. Ballynahinch.

†4. C. VERRUCOSUM, *Reinsch.* (*Contrib. ad Alg. et Fung.* taf. 13. fig. 8; *Contrib. ad Flor. Alg. aq. dulc. Promont.* pl. 6. fig. 3.)
II. Adrigole.

5. C. MICROPORUM, *Naeg.* (*Rabh. Fl. Europ. Alg.* iii. p. 80.)
I. Near Westport; Ballynahinch; Nacoogarrow Lough.—II. Upper and Lower Lakes of Killarney; Adrigole.

II. PROTOPHYTA.

Group *SCHIZOPHYCEÆ*.

Class Protococcoideæ.

Ord. Eremobieæ.

1. Sciadium arbuscula, *A. Br.* [Ophiocytium arbuscula, *Rabh. Fl. Europ. Alg.* iii. p. 68.]
I. Near Westport.

1. Ophiocytium cochleare, *A. Br.* (*Rabh. l. c.* p. 67.)
I. Roundstone; near Westport; near Oughterard; Lakes near Recess; Ballynahinch; Letereen Lough; Lough Shannacloontippen.—II. Carrantuohill; Lower Lake of Killarney; Glen Caragh.

1. Dictyosphærium Ehrenbergianum, *Naeg.* (*Rabh. l. c.* p. 47.)
I. Lough Aunierin; Ballynahinch.—II. Castletown; Glen Caragh.

1. Apiocystis Brauniana, *Naeg.* (*Rabh. l. c.* p. 43.)
I. Near Westport.—II. Lower Lake of Killarney, on *Œdogonium*, sp.

1. Hydrianum heteromorphum, *Reinsch.* (*Contrib. ad Algol.* p. 80, tab. 11. fig. 3.)
I. Kylemore; Ballynahinch.—II. Carrantuohill; Lower Lake of Killarney; Glen Caragh; near Lough Brin; Adrigole.

1. Nephrocytium Agardhianum, *Naeg.*
I. Lakes, Clifden to Roundstone; Boy Lough.—II. Muckross.

2. N. Nagelii, *Grun.* (*Rabh. Fl. Europ. Alg.* p. 52.)
II. Glengarriff; Lower Lake of Killarney.

1. Oocystis gigas, *Arch.* (*Quart. Journ. Micr. Sc.* 1877, p. 105.)
I. Lough Shannacloontippen.

†2. Oocystis Nägelii, *A. Br.* (*Rabh. Fl. Europ. Alg.* iii. p. 53.)

II. 8 m. S. of Kenmare.

†3. O. solitaria, *Wittr. in Nord. et Wittr. Alg. Exsic.* no. 244.

I. Clifden.

Ord. Protococcaceæ (incl. *Palmellaceæ*.)

1. Porphyridium cruentum, *Naeg.* (*Rabh. Fl. Europ. Alg.* iii. p. 397.)

II. Castletown.

1. Pleurococcus vulgaris, *Menegh.* (*Rabh. l. c.* p. 24.)

I. Common.—II. Common.

2. P. angulosus, *Menegh.* (*Rabh. l. c.* p. 24.)

Crass. cell. 10–15 μ; crass. membr. cell. 1·5–2·5 μ.

I. Near Westport.

†1. Acanthococcus aciculiferus, *Lagerh.* (*Bidrag till Sver. Alg. Fl.* tab. 1. fig. 21.)

Diam. sine acul. 20 μ; diam. cum acul. 26 μ; long. acul. 3 μ.

II. Cromagloun.

†2. A. sp. (Pl. XVIII. fig. 14.)

A. cellulis solitariis vel in familiis parvis conglomeratis, globosis; membrana cellularum crassa, aciculis validis brevibus numerosissimis ornata.

Diam. (sine acul.) 34–42 μ; long. ac. 3–4 μ.

Burren Hills, Co. Clare.

1. Chlorococcum Gigas, *Grun.* (*Rabh. Fl. Europ. Alg.* iii. p. 59.)

I. Near Westport; Lakes, Clifden to Roundstone; Oorid Lough.—II. Lough Guitane.

††Var. maximum, nov. var. (Pl. XVIII. fig. 13.)

Var. cellulis majoribus, fere quatuor in familiam tetraëdrice ordinatis.

Diam. cell. 22–28 μ.

I. Derryclare Lough.

2. CHLOROCOCCUM HUMICOLA, *Rabh.* (*Fl. Europ. Alg.* iii. p. 58.)

II. Lough Guitane.

1. GLŒOCYSTIS AMPLA, *Rabh.* (*Fl. Europ. Alg.* iii. p. 29.)

I. Lough Aunierin; near Recess; Creggan Lough; Lakes, Clifden to Roundstone; Lakes east of Lough Bofin; Lough Shannacloontippen; near Westport.—II. Near Lough Brin; Adrigole.

2. G. RUPESTRIS, *Rabh.* (*L. c.* p. 30.)

I. Lough Shannacloontippen; Derryclare Lough.—II. Near Killarney.

3. G. VESICULOSA, *Naeg.* (*Rabh. l. c.* p. 29.)

Diam. cell. 7–9 μ.

I. Derryclare Lough; Roundstone; Oorid and Nabincka Loughs.—II. Upper Lake of Killarney; Carrantuohill; near Lough Brin; 8 m. S. of Kenmare.

4. G. BOTRYOIDES (*Kuetz.*), *Naeg.* (*Rabh. l. c.* p. 30.)

I. Derryclare Lough.

1. EREMOSPHÆRA VIRIDIS, *De Bary.* (*Rabh. Fl. Europ. Alg.* iii. p. 24.)

I. Lough Creggan; Lakes near Recess.—II. Cromagloun; Clogerheen; Lower Lake of Killarney; Castletown; Adrigole.

††1. BOTRYOCOCCUS CALCAREUS, nov. sp. (Pl. XVIII. fig. 6.)

B. thallo minimo subgloboso circiter 32 cellularum, libere natantium vel in massas parvas aggregatarum; cellulis ovato-cuneatis, polo latiore subemarginato et polo angustiore verso medio thalli.

Diam. fam. 30–55 μ; long. cell. 9–12·5 μ; lat. cell. 10–12·5 μ; crass. cell. 7·5–10 μ.

Frequent amongst *Spirogyra* in small limestone pools on the Burren Hills, Co. Clare.

This differs from *B. Braunii*, Kuetz., in the *very different* shape of the cells and in not having them so densely packed.

2. B. BRAUNII, *Kuetz.* (*Rabh. Fl. Europ. Alg.* iii. p. 43.)

I. Near Oughterard; Lakes, Clifden to Roundstone.—II. Cromagloun; Carrantuohill; Lower Lake of Killarney; Castletown; Glen Caragh; 8 m. S. of Kenmare.

1. UROCOCCUS INSIGNIS, *Kuetz.* [Chroococcus macrococcus, *Rabh.*, *et* var. aureus, *Rabh.* (*Fl. Europ. Alg.* ii. p. 33).]

I. Lough Aunierin; Lakes, Clifden to Roundstone; Ballynahinch.—II. Carrantuohill.

1. RHAPHIDIUM POLYMORPHUM, *Fresen.*, var. ACICULARE (*A. Br.*), *Rabh.* (*Fl. Europ. Alg.* iii. p. 45.)

II. Lower Lake of Killarney.

Var. FALCATUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 45.)

I. Near Westport; Creggan Lough; Baheh Loughs; Ballynahinch; Lough Shannacloontippen; Lakes, Clifden to Roundstone.—II. Lough Guitane; Cromagloun; Muckross; Upper and Lower Lakes of Killarney; Glen Caragh; near Lough Brin; Carrantuohill.

1. SCENEDESMUS BIJUGATUS, *Kütz.* [Scenedesmus obtusus, *Meyen*; S. quadricauda, *Turp.*, var. ecornis (*Ehrenb.*), *Ralfs* (*Brit. Desm.* p. 190, tab. 31. fig. 12 *h* et *i*).]

I. Near Westport; Clifden; Lough Shannacloontippen.—II. Lough Guitane; Upper Lake of Killarney.

†2. S. ALTERNANS, *Reinsch.* (*Alg. Fl.*)

I. Lough Shannacloontippen; near Oughterard; near Recess; Clifden.—II. Carrantuohill; Adrigole.

†3. S. DENTICULATUS, *Lagerh.* (*Bg. till Stockh. Pediastr., Protococc. och Palmell.* p. 61, tab. 2. figs. 13–16.)

Long. cell. 12·5–14 μ; crass. cell. 7·5–9 μ.

I. Ballynahinch; Lough Shannacloontippen.

††Var. LINEATUS, nov. var. (Pl. XVIII. fig. 7.)

Var. cellulis oblongis angustioribus et in unam seriem ordinatis, nec cruciatim nec alternatim; cum 2–3 dentibus parvis.

Long. cell. 10–11 μ; crass. cell. 2·5–4 μ.

I. Derryclare Lough.

4. S. QUADRICAUDA, *Bréb.* (*Ralfs, Brit. Desm.* p. 190, tab. 31. fig. 12 *a–f*.)

I. Baheh Loughs; Lough Aunierin; Ballynahinch; near Westport; Derryclare Lough; Creggan Lough; Lough Shannacloontippen.—II. Lough Guitane; Lower Lake of Killarney; Clogerheen.

Var. ABUNDANS, *Kirchn.* [S. quadricauda, *Bréb.*, var. β, *Ralfs* (*Brit. Desm.* p. 190, tab. 31. fig. 12 *g*).]

I. Lough Shannacloontippen.—II. Lower Lake of Killarney.

5. SCENEDESMUS ANTENNATUS, *Bréb.*, *in Ralfs*, *Brit. Desm.* p. 222, tab. 35. fig. 27.

I. Creggan Lough; Boy Lough; near Oughterard; Lough Shannacloontippen.—II. Lough Guitane.

6. S. ACUTUS, *Meyen.* (*Ralfs*, *Brit. Desm.* p. 191, tab. 31. fig. 14.)

I. Near Westport; Lakes E. of Lough Bofin; Ballynahinch; Derryclare Lough; Letereen, Shindilla, Nabincka, and Aunierin Loughs; Lakes, Clifden to Roundstone.—II. Lough Guitane; Upper and Lower Lakes of Killarney; Clogerheen; Glengarriff; Cloonee Lough; Adrigole; near Lough Brin.

Var. OBLIQUUS, *Rabh.* (*Fl. Europ. Alg.* iii. p. 64.) [S. obliquus, *Kuetz.*]

I. Creggan, Derryclare, and Nabincka Loughs; Letereen Lough.—II. Carrantuohill.

Var. DIMORPHUS, *Rabh.* (*l. c.*). [S. dimorphus, *Kuetz.*]

I. Lough Shannacloontippen.—II. Lough Guitane.

†1. POLYEDRIUM MINIMUM, *A. Br.* [P. Pinacidium, *Reinsch.*]

I. Lakes, Clifden to Roundstone; Oorid Lough; Derryclare Lough.

2. P. TETRAËDRICUM, *Naeg.* (*Rabh. Fl. Europ. Alg.* iii. p. 62.) (Pl. XVIII. fig. 15.)

Lat. 30–35 μ.

I. Moher Lough.—II. Lower Lake of Killarney.

†3. P. CAUDATUM, *Lagerh.* (*Bidrag till Sver. Alg. Fl.*) [P. pentagonum, *Reinsch.*]

I. Near Westport; Lakes east of Lough Bofin.

4. P. LONGISPINUM, *Rabh.* (*Fl. Europ. Alg.* iii. p. 62.)

I. Baheh Loughs.

5. P. ENORME, *De Bary.* (*L. c.* p. 63.)

I. Near Westport.—II. Cromagloun; Sugar Loaf Mt.; near Lough Brin; Castletown; Glengarriff.

Class Cyanophyceæ or Phycochromaceæ.

Subclass Nostochineæ.

Ord. Nostocaceæ.

1. Nostoc sphæricum, *Vauch.* (*Rabh. Fl. Europ. Alg.* ii. p. 167.)

Diam. thall. 2·5–7 mm.; diam. cell. veget. 4–4·5 μ; diam. heterocyst. 6–7·5 μ.

II. Torc Mt.

1. Cylindrospermum macrospermum, *Kuetz.* (*Rabh. l. c.* p. 186.)

II. Muckross.

††1. Anabæna (Sphærozyga) orthogona, nov. sp. (Pl. XVIII. fig. 8.)

A. trichomatibus subrectis, dispersis, dissepimentis constrictis, pallide ærugineis, articulis subquadratis; heterocystidibus globosis; sporis geminis vel singulis, magnis subrectangularibus diametro 3–4plo longioribus, membranis hypopachydermaticis.

Diam. cellularum veget...........	5 μ;
„ heterocystidum	6–7·5 μ;
crassit. sporarum adultarum......	10–12 μ;
long. „ „	30–38 μ.

II. In peaty pools north of Cromagloun.

The vegetative cells generally appear distinct from each other, being apparently connected by the mucilage; the decidedly truncate spores, which are fully twice the diameter of the vegetative cells, are characteristic.

2. A. Hassallii, *Wittr.* [Sphærozyga Hassallii, *Rabh. l. c.* p. 195.]

Long. cell. veget. 7·5–10 μ; crass. cell. veget. 5·5–7 μ; long. spor. adult. 17·5–22·5 μ; crass. spor. adult. 7–8 μ.

I. Near Westport.

Ord. Rivulariaceæ.

1. Calothrix Dillwyni, *Cooke.* (*Brit. Freshw. Alg.* p. 276, tab. 113. fig. 2.)

II. Cloonee Lough.

1. Rivularia calcarea, *Sm. Eng. Bot.* (tab. 1799).
I. Near Westport.

2. R. granulifera, *Carm.* (*Cooke, Br. Freshw. Alg.* pl. 115. fig. 1.)
Diam. trich. 4–12 μ.
II. Torc Mt.

3. R. echinata, *Cooke.* (*Cooke, l. c.* tab. 114. fig. 2.)
I. Lakes near Recess.

Ord. Scytonemaceæ.

1. Tolypothrix Aegagropila, *Kuetz.* (*Rabh. Fl. Europ. Alg.* ii. p. 274.)
Articulis diametro paulo longioribus.
Diam. trich. cum vag. 15 μ.
I. Lakes, Clifden to Roundstone.

2. T. pygmea, *Kuetz.* (*Rabh. l. c.* p. 275.)
Diam. trich. 8–10 μ; long. heterocyst. 8·5–10 μ; crass. heterocyst. 6·5–8·5 μ.
I. Lakes, Clifden to Roundstone.
A small form (diam. trich. 6·5–7 μ) with single heterocysts was noticed which may belong to *T. tenuis*, Kuetz.
I. Athry Lake.

1. Petalonema alatum, *Berk.* [Arthrosiphon alatus (*Grev.*), *Rabh. l. c.* p. 265.]
I. Ballynahinch.

†1. Scytonema calotrichoides, *Kuetz.* (*Rabh. Fl. Europ. Alg.* ii. p. 253.)
Lat. sine vag. 12·5–13 μ; lat. cum vag. 17–20 μ.
II. 8 m. S. of Kenmare.
A form with the branchlets both geminate and single, they were also frequent; the heterocysts differed from those of the type in being rotund-elliptic.
Lat. trich. sine vag. 7–8 μ; cum vag. 9–11 μ.
II. Cromagloun.

2. S., sp.
Diam. trich. 12–15 μ; cum vag. 23–25 μ.

This *Scytonema* approaches large forms of *S. tolypotrichoides*, Kuetz., but it has a comparatively thicker internal trichome; it was only seen in small quantity.

II. Upper Lake of Killarney.

1. Stigonema minutum, *Hass.* [Sirosiphon saxicola, *Naeg.*] (*Cooke, Brit. Freshw. Alg.* p. 273, pl. 110. fig. 1.)

Diam. trich. cum vag. 20–28 μ; diam. trich. sine vag. 15–18 μ.

I. Athry Lake.—II. Cloonee Lough.

2. S. turfaceum, *Cooke.* (*Brit. Freshw. Alg.* p. 272, tab. 111. fig. 2.)

II. 8 m. S. of Kenmare.

The last two are probably Lichens when mature.

Ord. Oscillariaceæ.

1. Oscillaria princeps, *Vauch.* (*Rabh. Fl. Eur. Alg.* ii. p. 112.)

Lat. 30–32 μ.

I. Near Westport.—II. Sugar Loaf Mt.; Adrigole; Castletown; Glengarriff.

2. O. Frolichii, *Kuetz.* (*Rabh. Fl. Europ. Alg.* ii. p. 109; *Cooke's Brit. Freshw. Alg.* p. 253, tab. 97. fig. 7.)

I. Creggan Lough.

3. O. nigro-viridis, *Thw.* (*Rabh. Fl. Europ. Alg.* ii. p. 292; *Cooke's Brit. Freshw. Alg.* p. 252, tab. 98. fig. 2.)

Lat. fil. 12·5 μ.

I. Near Westport.

4. O. limosa, *Ag.* (*Rabh. Fl. Europ. Alg.* ii. p. 104; *Cooke's Brit. Freshw. Alg.* p. 251, tab. 97. fig. 3.)

II. Cloonee Lough; Carrantuohill.

5. O. tenuis, *Ag.* (*Rabh. Fl. Europ. Alg.* ii. p. 102; *Cooke's Brit. Freshw. Alg.* p. 249, tab. 96. fig. 8.)

II. Castletown; Carrantuohill; Mallow.

6. O. leptotricha, *Kuetz.* (*Rabh. Fl. Europ. Alg.* ii. p. 96; *Cooke's Brit. Freshw. Alg.* p. 247, tab. 96. fig. 5.)

Lat. fil. 3 μ.

I. Near Westport.

7. Oscillaria tenerrima, *Kuetz.* (*Rabh. Fl. Eur. Alg.* ii. p. 96; *Cooke, Brit. Freshw. Alg.* p. 247, tab. 96. fig. 4.)
I. Derryclare Lough.—II. Carrantuohill.

1. Microcoleus Müllerii, *nob.* [Schizothrix Müllerii, *Naeg.* (*Rabh. Fl. Europ. Alg.* ii. p. 269).]
Diam. trich. 9–12 μ; diam. vag. 30 μ.
II. Lower Lake of Killarney.

1. Lyngbya subfusca, *Cooke.* (*Brit. Freshw. Alg.* p. 262, tab. 101. fig. 3.)
I. Moher Lough.

†1. Spirulina turfosa, *Cram.* (*Hedwigia*, ii. p. 61, tab. 12. fig. 1.)
Diam. trich. 4·5–5 μ.
I. Near Westport.

2. S. tenuissima, *Kuetz.* (*Rabh. Fl. Europ. Alg.* ii. p. 92.)
I. Near Westport.

Subclass Chroococcaceæ.

Ord. Chroococcaceæ.

1. Chroococcus turgidus, *Naeg.* (*Rabh. Fl. Europ. Alg.* ii. p. 32.)
I. Near Westport; Kylemore; Clifden; Ballynahinch.—II. Torc Mt.; Glen Caragh.

2. C. cohærens, *Naeg.* (*Cooke, Brit. Freshw. Alg.* p. 204, pl. lxxxiii. fig. 1.)
I. Derryclare Clough; Boy Lough.

1. Glœocapsa æruginosa, *Kuetz.* (*Rabh. Fl. Eur. Alg.* ii. p. 39; *Cooke, Brit. Freshw. Alg.* p. 207, tab. 84. fig. 2.)
II. Carrantuohill.

2. G. magma, *Kuetz.* (*Rabh. Fl. Eur. Alg.* ii. p. 42; *Cooke, Brit. Freshw. Alg.* p. 208, tab. 84. fig. 3.)
II. Torc Mt.

3. G. rupicola, *Kuetz.* (*Rabh. Fl. Eur. Alg.* ii. p. 43; *Cooke, Brit. Freshw. Alg.* p. 208, tab. 84. fig. 4.)
II. Near Killarney.

1. Synechococcus æruginosus, *Naeg.* (*Rabh. Fl. Eur. Alg.* ii. p. 59.)

Long. 32–37 μ; lat. 21–24 μ.

I. Lough Aunierin; Lakes near Recess; near Westport.—II. Lough Guitane; Carrantuohill; Adrigole; 8 m. S. of Kenmare.

†1. Merismopedia æruginea, *Bréb.* (*Rabh. l. c.* p. 57.)

Crass. cell. 4·5–6 μ.

I. Lakes, Clifden to Roundstone.

2. M. glauca, *Naeg.* (*Rabh. l. c.* p. 56.)

I. Near Westport; Lough Aunierin; Lakes near Recess; Shindilla, Nabincka, and Derryclare Loughs; Letereen Lough; Ballynahinch; Boy Lough.—II. Lough Guitane; Castletown; Upper Lake of Killarney; Adrigole.

3. M. violacea, *Kuetz.* (*Rabh. l. c.* p. 57.)

II. Cloonee Lough.

†4. M. irregulare, *Lagerh.* (*Bidrag til Sver. Alg. Fl.* tab. 1. figs. 5 et 6.)

I. Arderry Lough.

1. Tetrapedia setigera, *Arch.* (*Grevillea,* i. p. 46, tab. 3. figs. 14–17.)

Diam. sine spin. 7·5 μ; long. spin. 6 μ; crass. 5 μ.

I. Kylemore.

1. Aphanocapsa Grevillei, *Rabh.* (*Fl. Europ. Alg.* ii. p. 50.)

A form with the cellules more densely crowded than usual.

II. Cromagloun; Torc Mt.

††Var. microgranula, nov. var. (Pl. XVIII. fig. 9.)

Var. cellulis multum minoribus et confertioribus.

Crass. cellulæ 2–2·5 μ.

I. In pools, free swimming, near Ballynahinch.

†1. Glaucocystis Nostochinearum, *Itz.* (*Rabh. Fl. Europ. Alg.* iii. Addenda &c. p. 417, c. fig.)

II. Near Lough Brin; Carrantuohill; Glen Caragh.

1. MICROCYSTIS MARGINATA, *Kirchn.* (*Cooke, Brit. Freshw. Alg.* p. 212, pl. lxxxvi. fig. 6.)
I. Lough Shannacloontippen.—II. Cromagloun.

2. M. PROTOGENITA, *Rabh.* (*Fl. Europ. Alg.* ii. p. 52.)
I. Creggan Lough; Shannacloontippen, Boy, Nabincka, and Oorid Loughs.—II. Lough Guitane; Upper and Lower Lakes of Killarney; Glengarriff; Cloonee Lough; Adrigole.

†1. APHANOTHECE SAXICOLA, *Naeg.* (*Rabh. l. c.* p. 63.)
I. Nacoogarrow Lough; Loughs Aunierin and Creggan.—II. Carrantuohill.

1. CŒLOSPHÆRIUM KUETZINGIANUM, *Naeg.* (*Rabh. l. c.* p. 55.)
I. Aunierin and Oorid Loughs; Shindilla Lough.

Class DIATOMACEÆ.

1. CYCLOTELLA OPERCULATA, *Kuetz.* (*W. Sm. Brit. Diat.* i. fig. 48.)
I. Derryclare Lough; Nacoogarrow Lough; Shindilla Lough; Clifden.—II. Torc Mt.; Lough Guitane; Lower Lake of Killarney.

2. C. KUETZINGIANA, *Thw.* (*W. Sm. l. c.* fig. 47.)
I. Near Westport; Roundstone.—II. Lough Guitane.

1. MELOSIRA VARIANS, *Ag.* (*W. Sm. Brit. Diat.* ii. p. 57, tab. 51. fig. 332.)
II. Lower Lake of Killarney; Carrantuohill; Mallow.

2. M. ARENARIA, *Moore.* [Orthosira arenaria, *W. Sm. l. c.* p. 59, tab. 52. fig. 334.]
II. Clogerheen.

1. SURIRELLA LINEARIS, *W. Sm.* (*Brit. Diat.* i. p. 31, fig. 58 *a.*)
I. Near Westport; Lakes near Recess.—II. Lough Guitane Lower Lake of Killarney; Glengarriff.

Var. CONSTRICTA, *Rabh.* (*Fl. Europ. Alg.* i. p. 52.)
II. Lough Guitane.

2. S. BISERIATA, *Bréb.* (*W. Sm. Brit. Diat.* i. p. 30, fig. 57.)
I. Near Westport; Lakes E. of Lough Bofin.—II. Glen Caragh; near Lough Brin; Glengarriff.

3. SURIRELLA APICULATA, *W. Sm.* (*Rabh. Fl. Europ. Alg.* i. p. 54.)

I. Moher Lough; Lakes E. of Lough Bofin.—II. Glengarriff.

4. S. SPLENDIDA, *Kuetz.* (*W. Sm. Brit. Diat.* p. 32, tab. 7. fig. 62.)

I. Creggan and Derryclare Loughs; Lakes E. of Lough Bofin.

5. S. NOBILIS, *W. Sm.* (*L. c.* fig. 63.)

I. Derryclare Lough.—II. Lough Guitane.

6. S. OVATA, *Kuetz.* (*W. Sm. l. c.* fig. 70.)

II. Mallow.

7. S. MINUTA, *Bréb.* (*W. Sm. l. c.* p. 34, fig. 73.)

II. Mallow.

1. CYMATOPLEURA ELLIPTICA, *W. Sm.* (*L. c.* p. 37, tab. 10. fig. 80.)

Burren Hills, Co. Clare.

2. C. SOLEA, *W. Sm.* (*L. c.* p. 36, tab. 10. fig. 78.)

I. Near Westport.—II. Mallow.

1. EPITHEMIA TURGIDA, *Kuetz.* (*W. Sm. Brit. Diat.* i. tab. 1; *Rabh. Fl. Europ. Alg.* p. 62.)

I. Lough Aunierin; near Westport.—II. Lower Lake of Killarney; near Lough Brin; Clogerheen.

2. E. WESTERMANNI, *Kuetz.* (*Pritch. Infus.* ed. 1861, p. 760, tab. 4. fig. 2.)

I. Lakes, Clifden to Roundstone; near Westport.—II. Muckross.

3. E. HYNDMANNI, *W. Sm.* (*Brit. Diat.* i. p. 12, tab. 1. fig. 1.)

II. Clogerheen.

4. E. SOREX, *Kuetz.* (*L. c.* tab. 1. fig. 9.)

I. Lough Aunierin.

5. E. GIBBA, *Kuetz.* (*L. c.* tab. 1. fig. 13.)

I. Creggan Lough; Lough Aunierin; near Westport; Lakes E. of Lough Bofin.—II. Muckross; near Lough Brin; Cromagloun; Torc Mt.; Lower Lake of Killarney.

6. Epithemia ventricosa, *Kuetz.* (*W. Sm. Brit. Diat.* tab. 1. fig. 14.)

I. Derryclare Lough.

7. E. alpestris, *W. Sm.* (*L. c.* tab. 1. fig. 7.)

II. Cromagloun; Muckross.

1. Eunotia incisa, *Greg.* (*Micr. Journ.* ii. p. 96, tab. 4. fig. 4.)

I. Lakes, Clifden to Roundstone; Oorid Lough; Nacoogarrow Lough.

2. E. diodon, *Ehrenb.* (*Rabh. Fl. Eur. Alg.* i. p. 69.)

I. Lakes near Recess; Kylemore; Oorid Lough; near Oughterard.—II. Lough Guitane.

3. E. tetraodon, *Ehrenb.* (*L. c.* p. 70.)

II. Lough Guitane; Glengarriff; 8 m. S. of Kenmare.

4. E. diadema, *Ehrenb.* (*L. c.* p. 70.)

I. Derryclare Lough.—II. Lough Guitane.

5. E. bidentula, *W. Sm.* (*L. c.* p. 71.)

I. Lakes, Clifden to Roundstone.

6. E. Arcus, *Ehrenb.* (*W. Sm. Brit. Diat.* ii. tab. 33. fig. 283.)

I. Lough Aunierin; Roundstone; near Westport.

7. E. majus, *W. Sm.* (*L. c.* fig. 286.)

II. Carrantuohill; Torc Mt.; Castletown.

Var. bidens, *W. Sm.* [Himantidium bidens, *Greg.* (*Micr. Journ.* ii. tab. 4. fig. 21).]

I. Lakes near Recess.

8. E. gracilis, *Ehrenb.* (*W. Sm. Brit. Diat.* fig. 285.)

I. Near Westport; Nacoogarrow, Aunierin, Letereen, and Derryclare Loughs; Lakes E. of Lough Bofin; Shindilla and Nabincka Loughs; Roundstone.—II. Lough Guitane; Torc Mt.; Carrantuohill; Castletown; Upper and Lower Lakes of Killarney; 8 m. S. of Kenmare.

9. E. monodon, *Ehrenb.* (*Rabh. Fl. Europ. Alg.* i. p. 73.)

II. Upper Lake of Killarney.

10. E. pectinalis, *Dillw.* (*Rabh. l. c.* p. 73; *W. Sm. Brit. Diat.* ii. fig. 280.)

I. Roundstone; Creggan, Aunierin, Moher, Letereen, Shindilla, Nabincka, and Derryclare Loughs; Ballynahinch; Lakes E. of

Lough Bofin; near Westport.—II. Lough Guitane; near Lough Brin; Glengarriff; Lower Lake of Killarney.

11. EUNOTIA SOLEIROLII, *Kuetz.* (*W. Sm. Brit. Diat.* ii. tab. 33. fig. 282.)

I. Near Westport.

1. CERATONEIS AMPHIOXYS, *Rabh.* (*Süssw. Diat.* p. 37, tab. 9. fig. 4.)

II. Muckross.

1. CYMBELLA EHRENBERGII, *Kuetz.* (*W. Sm. Brit. Diat.* i. p. 17, tab. 2. fig. 21.)

I. Near Westport; Creggan Lough.

2. C. CUSPIDATA, *Kuetz.* (*W. Sm. l. c.* fig. 22.)

I. Near Oughterard; near Westport; Moher Lough; Nabincka and Shindilla Loughs.—II. Glen Caragh; Glengarriff; Cloonee Lough.

3. C. TURGIDA, *Greg.* (*Micr. Journ.* iv. p. 5, tab. 1. fig. 18.)

I. Roundstone.—II. Carrantuohill; Adrigole.

4. C. MACULATA, *Kuetz.* (*W. Sm. l. c.* fig. 23.)

I. Lakes, Clifden to Roundstone; Nacoogarrow Lough.—II. Near Lough Brin; Mallow; Clogerheen.

1. COCCONEMA LANCEOLATUM, *Ehrenb.* (*W. Sm. l. c.* tab. 23. fig. 219.)

II. Muckross; Torc Mt.; Mallow; Clogerheen.

2. C. CYMBIFORME, *Ehrenb.* (*W. Sm. l. c.* fig. 220.)

I. Lough Aunierin; Creggan Lough; Roundstone; near Westport.—II. Muckross; Torc Mt.; near Lough Brin; Glengarriff; Lower Lake of Killarney; Lough Guitane; Clogerheen.

3. C. CISTULA, *Hempr.* (*Rabh. Fl. Europ. Alg.* i. p. 84.)

I. Aunierin and Derryclare Loughs; Roundstone; Creggan Lough.—II. Mallow; Lower Lake of Killarney; Torc Mt.; Clogerheen; Lough Guitane; Muckross.

4. C. PARVUM, *W. Sm.* (*Brit. Diat.* p. 76, fig. 222.)

I. Near Westport; Creggan Lough; Roundstone; Derryclare Lough.—II. Torc Mt.; Muckross; Lough Guitane; Cloonee Lough; Mallow.

1. ENCYONEMA CÆSPITOSUM, *Kuetz.* (*W. Sm. l. c.* ii. p. 68, tab. 55. fig. 346.)

I. Near Westport.

2. Encyonema gracile, *Rabh.* (*Fl. Europ. Alg.* i. p. 86.)
I. Near Westport; Lough Aunierin; Nacoogarrow Lough; Ballynahinch.—II. Muckross; Glengarriff; Clogerheen; Cloonee Lough; 8 m. S. of Kenmare.

1. Amphora ovalis, *Kuetz.* (*W. Sm. Brit. Diat.* i. tab. 2. fig. 26.)
I. Near Westport; Moher Lough.—II. Clogerheen; Ross Island.

1. Cocconeis Pediculus, *Ehrenb.* (*W. Sm. l. c.* i. tab. 3. fig. 31.)
II. Lower Lake of Killarney; Mallow.

2. C. Placentula, *Ehrenb.* (*W. Sm. l. c.* i. tab. 3. fig. 32.)
I. Near Westport; Lakes near Recess; Nabincka Lough.—II. Mallow; Clogerheen.

3. C. Thwaitesii, *W. Sm.* (*L. c.* i. tab. 3. fig. 33.)
I. Moher Lough; Clifden.—II. Muckross; Torc Mt.; Lough Guitane.

1. Achnanthidium microcephalum, *Kuetz.* (*W. Sm. l. c.* ii. tab. 61. fig. 380.)
I. Near Westport; Shindilla Lough.—II. Adrigole; 8 m. S. of Kenmare.

2. A. lanceolatum, *Bréb.* (*W. Sm. l. c.* ii. tab. 37. fig. 304.)
I. Near Westport.—II. Rossmacowen; Castletown.

1. Achnanthes exilis, *Kuetz.* (*W. Sm. l. c.* ii. p. 29, tab. 37. fig. 303.)
I. Derryclare, Nacoogarrow, Shindilla, Boy, Nabincka, Baheh, Shannacloontippen, and Moher Loughs; near Westport; Ballynahinch; Roundstone; Lakes, Clifden to Roundstone.—II. Torc Mt.; Muckross; Glengarriff; Lough Guitane; Mallow.

2. A. subsessilis, *Kuetz.* (*W. Sm. l. c.* p. 28, tab. 37. fig. 302.)
II. Rossmacowen.

1. Odontidium hyemale, *Kuetz.* (*W. Sm. l. c.* p. 15, tab. 34. fig. 289)
II. Mallow.

2. O. mesodon, *Kuetz.* (*W. Sm. l. c.* tab. 34.)
I. Roundstone.—II. Torc Mt.; Lower Lake of Killarney; Carrantuohill.

3. ODONTIDIUM MUTABILE, *W. Sm.* (*Brit. Diat.* ii. p. 17, tab. 34. fig. 290.)

I. Near Westport; Nacoogarrow and Shindilla Loughs; Nabincka and Derryclare Loughs.—II. Clogerheen; Lough Guitane; Upper Lake of Killarney; Glengarriff; 8 m. S. of Kenmare.

1. FRAGILARIA CAPUCINA, *Desmaz.* (*W. Sm. l. c.* tab. 35. fig. 296.)

II. Clogerheen; Carrantuohill; Lower Lake of Killarney; Mallow.

1. DIATOMA VULGARE, *Bory.* (*W. Sm. l. c.* p. 39, tab. 40. fig. 309.)

I. Lakes near Recess.

2. D. ELONGATUM, *Ag.* (*W. Sm. l. c.* tab. 40. fig. 311.)

I. Boy Lough; Moher, Creggan, Baheh, and Shindilla Loughs; Roundstone; Ballynahinch.

1. SYNEDRA LUNARIS, *Ehrenb.* (*W. Sm. l. c.* i. p. 69, tab. 11. fig. 82.)

I. Moher, Nacoogarrow, Aunierin, Baheh, Derryclare, and Shindilla Loughs; Ballynahinch; near Westport; Roundstone; Lakes E. of Lough Bofin, and from Clifden to Roundstone.—II. Cloonee Lough; near Lough Brin; Upper and Lower Lakes of Killarney; Torc Mt.; Carrantuohill; Clogerheen; Adrigole; Glengarriff; 8 m. S. of Kenmare.

2. S. BICEPS, *Kuetz.* (*Rabh. Fl. Europ. Alg.* i. p. 130.)

I. Near Westport.—II. Adrigole.

3. S. PULCHELLA, *Kuetz.* (*W. Sm. Brit. Diat.* i. p. 70, tab. 11. fig. 84.)

I. Moher Lough; Shindilla Lough.—II. Muckross; Glen Caragh; Lower Lake of Killarney; Mallow.

4. S. ULNA, *Ehrenb.* (*Rabh. Fl. Europ. Alg.* i. p. 133.)

II. Torc Mt.; Upper and Lower Lakes of Killarney; near Lough Brin; Lough Guitane; Mallow.

5. S. SPLENDENS, *Kuetz.* (*Rabh. l. c.* p. 134.)

I. Moher, Boy, and Nacoogarrow Loughs; Lakes E. of Lough Bofin; near Oughterard; Baheh Loughs; Derryclare.—II. Lower Lake of Killarney; Clogerheen; Lough Guitane.

6. S. CAPITATA, *Ehrenb.* (*W. Sm. Brit. Diat.* i. p. 72, tab. 12. fig. 93.)

II. Clogerheen; Ross Island.

7. Synedra Acus, *Kuetz.* (*Rabh. Fl. Europ. Alg.* i. p. 136.)

I. Baheh Loughs.—II. Lough Guitane.

Var. apiculata, *Rabh.* (*L. c.* p. 136.)

I. Nabincka and Shindilla Loughs; Nacoogarrow Lough.—II. Lough Guitane.

8. S. delicatissima, *Kuetz.* (*W. Sm. Brit. Diat.* i. tab. 12. fig. 94.)

I. Near Westport; Lough Shindilla; Ballynahinch; Derryclare Lough.—II. Clogerheen.

1. Asterionella formosa, *Hass.* (*W. Sm. l. c.* ii. p. 81.)

I. Baheh Loughs; Moher Lough; Kylemore; near Westport.—II. Torc Mt.; Lower Lake of Killarney.

1. Amphipleura pellucida, *Kuetz.* (*W. Sm. l. c.* i. p. 45, fig. 127.)

I. Derryclare Lough; Ballynahinch; near Westport.—II. Ross Island.

1. Nitzschia Amphioxys, *W. Sm.* (*Brit. Diat.* i. p. 40, tab. 13. fig. 105.)

I. Roundstone.—II. Castletown; 8 m. S. of Kenmare; Rossmacowen.

2. N. vivax, *W. Sm.* (*L. c.* tab. 31. fig. 267.)

II. Mallow.

3. N. parvula, *W. Sm.* (*L. c.* tab. 13. fig. 106.)

I. Near Westport.

4. N. sigmoidea, *W. Sm.* (*L. c.* tab. 13. fig. 104.)

II. Mallow.

5. N. curvula, *W. Sm.* (*Rabh. Fl. Europ. Alg.* i. p. 156.)

I. Lakes near Recess, and from Clifden to Roundstone; near Westport; Derryclare Lough.—II. Glengarriff; near Lough Brin; Upper Lake of Killarney; Cloonee Lough.

6. N. linearis, *W. Sm.* (*Brit. Diat.* i. p. 39, tab. 13. fig. 110.)

II. Cloonee Lough.

7. N. tenuis, *W. Sm.* (*L. c.* p. 40, tab. 13. fig. 111.)

II. Glengarriff; Torc Mt.

8. N. minutissima, *W. Sm.* (*L. c.* p. 41, tab. 13. fig. 107.)

I. Derryclare Lough.

1. NITZSCHIELLA ACICULARIS, *Rabh.* (*Fl. Europ. Alg.* i. p. 164.)

I. Lakes near Recess.

1. NAVICULA CUSPIDATA, *Kuetz.* (*W. Sm. Brit. Diat.* i. p. 47, tab. 16. fig. 131.)

I. Near Westport.

2. N. RHOMBOIDES, *Ehrenb.* (*W. Sm. l. c.* i. p. 46, tab. 16. fig. 129.)

I. Lough Aunierin; Ballynahinch; near Westport.—II. Glen Caragh; Upper and Lower Lakes of Killarney; 8 m. S. of Kenmare.

3. N. SERIANS, *Kuetz.* (*W. Sm. l. c.* tab. 16. fig. 130.)

I. Derryclare Lough; Ballynahinch; near Westport.

4. N. ELLIPTICA, *Kuetz.* [N. ovalis, *W. Sm. l. c.* p. 48, tab. 17. fig. 153.]

II. Torc Mt.

5. N. GIBBERULA, *W. Sm.* (*L. c.* p. 51, tab. 17. fig. 160.)

I. Creggan Lough.—II. Lough Guitane; Ross Island (forma leviter inflata in medio).

6. N. INFLATA, *Kuetz.* (*W. Sm. l. c.* p. 50, tab. 17. fig. 158.)

II. Torc Mt.

7. N. AMPHISBÆNA, *Bory.* (*W. Sm. l. c.* tab. 17. fig. 147.)

I. Near Westport; Shindilla Lough; Lakes E. of Lough Bofin.

8. N. SPHÆROPHORA, *Kuetz.* (*W. Sm. l. c.* tab. 17. fig. 148.)

II. Glengarriff; Cloonee Lough.

9. N. PUSILLA, *W. Sm.* (*L. c.* fig. 145.)

II. Rossmacowen; Castletown.

10. N. ANGLICA, *Ralfs*, f. CRASSA. [N. tumida, *W. Sm. Brit. Diat.* i. tab. 17. fig. 146.]

I. Lough Aunierin.

11. N. RHYNCHOCEPHALA, *Kuetz.* (*W. Sm. l. c.* p. 47, tab. 16. fig. 132.)

I. Boy Lough; Nabincka Lough.

Forma ROBUSTA, *Rabh.* (*Rabh. Fl. Europ. Alg.* i. p. 196.)

I. Near Westport.

Forma PARVA, *Rabh.* [N. dirhyncus, *Ehrenb.*] (*L. c.* p. 196.)

I. Near Oughterard.

12. NAVICULA AMPHIRHYNCUS, *Ehrenb.* (*W. Sm. Brit. Diat.* i. tab. 16. fig. 142.)

I. Ballynahinch; Kylemore; Shindilla and Derryclare Loughs; Lakes E. of Lough Bofin; near Westport.

13. N. PRODUCTA, *W. Sm.* (*L. c.* fig. 144.)

II. Glengarriff.

14. N. EXILIS, *Grun.* (*Rabh. Fl. Europ. Alg.* i. p. 198.)

I. Derryclare Lough; Lakes, Clifden to Roundstone; Nacoogarrow Lough; Roundstone.—II. Cloonee Lough.

15. N. ANGUSTATA, *W. Sm.* (*Brit. Diat.* p. 52, tab. 17. fig. 156.)

I. Derryclare Lough; Lakes near Recess.—II. Torc Mt.; Castletown.

16. N. CRYPTOCEPHALA, *Kuetz.* (*W. Sm. l. c.* fig. 155.)

I. Near Westport; Moher and Nabincka Loughs; Roundstone.—II. Glengarriff; Clogerheen; Mallow.

Var. LANCEOLATA, *Grun.* (*Rabh. Fl. Europ. Alg.* i. p. 198.)

II. Lower Lake of Killarney.

17. N. DICEPHALA, *Ehrenb.* (*W. Sm. Brit. Diat.* i. p. 53, tab. 17. fig. 157.)

I. Creggan, Shindilla, and Moher Loughs.—II. Adrigole; Cloonee Lough; Carrantuohill.

18. N. UNDOSA, *Ehrenb.* (*Rabenh. Süssw. Diat.* tab. 6. fig. 56.)

I. Lakes, Clifden to Roundstone; Lough Aunierin.

1. PINNULARIA NOBILIS, *Ehrenb.* (*W. Sm. Brit. Diat.* i. p. 54, tab. 17. fig. 161.)

I. Near Oughterard; Ballynahinch.—II. Lough Guitane; near Lough Brin; Muckross; Carrantuohill.

2. P. MAJOR, *Rabh.* (*W. Sm. l. c.* tab. 18. fig. 162.)

I. Near Oughterard; near Westport; Shindilla and Creggan Loughs.—II. Cromagloun; Clogerheen; Upper Lake of Killarney.

3. P. RABENHORSTII, *Ralfs.* (*Rabh. Fl. Europ. Alg.* i. p. 211.)

I. Near Westport; Ballynahinch; Loughs Shindilla and Aunierin; Lakes near Recess.—II. Lough Guitane; Adrigole; Lower Lake of Killarney; Glengarriff; Cloonee Lough.

4. PINNULARIA TABELLARIA, *Ehrenb.* (*W. Sm. Brit. Diat.* i. tab. 19. fig. 181.)

I. Near Westport; Lakes near Recess.—II. Glengarriff; Upper Lake of Killarney.

Var. ACROSPHÆRIA, *Rabh.* (*W. Sm. l. c.* tab. 19. fig. 183.)

I. Lakes near Recess; Ballynahinch; near Westport.—II. Cromagloun; Muckross; Castletown; Clogerheen.

5. P. GIBBA, *Ehrenb.* (*W. Sm. l. c.* fig. 180.)

I. Near Westport; Aunierin and Moher Loughs; Lakes E. of Lough Bofin and near Recess.—II. Lough Guitane; Muckross; Cromagloun; Lower Lake of Killarney; near Lough Brin; Glengarriff.

6. P. VIRIDIS, *W. Sm.* (*L. c.* tab. 18. fig. 163.)

I. Near Westport; Roundstone; Shannacloontippen, Shindilla, Oorid, and Creggan Loughs; Lakes E. of Lough Bofin.—II. Torc Mt.; Cromagloun; Glengarriff; Carrantuohill; Mallow; Lower Lake of Killarney; Clogerheen.

7. P. HEMIPTERA, *Rabh.* (*Fl. Europ. Alg.* i. p. 212.)

I. Derryclare Lough.

8. P. PEREGRINA, *Ehrenb.* (*W. Sm. Brit. Diat.* i. tab. 18. fig. 170.)

I. Derryclare Lough; Lakes, Clifden to Roundstone; near Westport; Moher Lough.—II. Muckross.

9. P. ALPINA, *W. Sm.* (*L. c.* p. 55, tab. 18. fig. 168.)

I. Derryclare Lough.—II. Carrantuohill.

10. P. RADIOSA, *Rabh.* (*W. Sm. l. c.* p. 56, tab. 18. fig. 173.)

I. Shannacloontippen, Aunierin, Derryclare, and Moher Loughs; Roundstone; near Westport.—II. Mallow.

Var. ANGUSTA, *Rabh.* (*Fl. Europ. Alg.* i. p. 215.)

I. Near Oughterard; Clifden; Derryclare Lough; Nacoogarrow Lough.—II. Adrigole.

11. P. ACUMINATA, *W. Sm.* (*Brit. Diat.* i. p. 55, tab. 18. fig. 164.)

I. Near Westport.

12. P. ACUTA, *W. Sm.* (*L. c.* fig. 171.)

I. Near Westport; Boy Lough; Creggan Lough.

13. Pinnularia mesolepta, *W. Sm.* (*Brit. Diat.* i. p. 58, tab. 19. fig. 182.)

I. Ballynahinch; near Westport; Kylemore; Lough Aunierin; Lakes near Recess.

14. P. divergens, *W. Sm.* (*L. c.* p. 57, tab. 19. fig. 178.)

I. Derryclare Lough.—II. Lough Guitane; Carrantuohill.

15. P. Brebissonii, *Rabh.* (*Fl. Europ. Alg.* i. p. 222.)

I. Derryclare Lough; near Westport.—II. Cloonee Lough.

1. Frustulia saxonica, *Rabh.*, forma aquatica, *Rabh.* (*Fl. Europ. Alg.* i. p. 227.)

I. Near Westport; Athry Lake; Ballynahinch; Clifden; Nacoogarrow and Derryclare Loughs; Lough Aunierin.—II. Lough Guitane; Torc Mt.; Glengarriff; Upper and Lower Lakes N. of Killarney; Carrantuohill; Cloonee Lough; 8 m. S. of Ke[illegible]

1. Pleurosigma lacustre, *W. Sm.* (*Brit. Diat.* i. p. 66, tab. 21. fig. 217.)

I. Near Westport.

1. Stauroneis Phœnicenteron, *Ehrenb.* (*W. Sm. l. c.* p. 59, tab. 19. fig. 185.)

I. Near Westport; near Leenane; Kylemore; Ballynahinch; near Oughterard; Moher Lough; Shindilla and Baheh Loughs; Lakes E. of Lough Bofin.—II. Sugar Loaf Mt.; near Lough Brin; Glengarriff; Clogerheen; Cloonee Lough.

2. S. gracilis, *Ehrenb.*, forma, *Rabh.* [S. gracilis, *W. Sm.*] (*L. c.* p. 59, tab. 19. fig. 186.)

I. Near Westport; Moher Lough.

3. S. anceps, *Ehrenb.* (*W. Sm. l. c.* fig. 190.)

I. Lakes E. of Lough Bofin; Loughs Aunierin and Shindilla. —II. Glengarriff; Cloonee Lough.

Forma linearis, *Rabh.* (*Fl. Europ. Alg.* i. p. 247.)

I. Near Oughterard.

1. Pleurostaurum Legumen, *Rabh.* [Stauroneis linearis, *W. Sm.* (*Brit. Diat.* i. p. 60, tab. 19. fig. 193).]

I. Near Westport.

1. Mastogloia Smithii, *Thw.* (*Brit. Diat.* i. tab. 54. fig. 341.)
II. Cloonee Lough.

1. Gomphonema tenellum, *Kuetz.* (*W. Sm. l. c.* i. p. 80, tab. 29. fig. 243.)
I. Nabincka Lough; Baheh and Nacoogarrow Loughs; Derryclare Lough.—II. Carrantuohill.

2. G. dichotomum, *Kuetz.* (*W. Sm. l. c.* fig. 240.)
I. Lakes, Clifden to Roundstone; Derryclare, Shindilla, Moher, and Nabincka Loughs; Lakes E. of Lough Bofin; Roundstone; near Recess.—II. Torc Mt.; Castletown; Muckross; Carrantuohill; Clogerheen; Cloonee Lough.
Forma distincte constricta infra apices.
I. Lakes, Clifden to Roundstone.

3. G. Vibrio, *Ehrenb.* (*W. Sm. l. c.* p. 81, tab. 28. fig. 242.)
I. Kylemore.

Var. hebridense, *Rabh.* (*Fl. Europ. Alg.* p. 287.)
I. Lough Aunierin.

4. G. capitatum, *Ehrenb.* (*W. Sm. Brit. Diat.* i. p. 80, tab. 28. fig. 237.)
II. Lower Lake of Killarney.

5. G. constrictum, *Ehrenb.* (*W. Sm. l. c.* p. 78, tab. [illegible] fig. 236.)
I. Moher Lough.—II. Torc Mt.; Clogerheen; Lower [illegible] of Killarney; Mallow.

6. G. geminat[illegible] *Ag.* (*W. Sm. l. c.* p. 78, tab. 27. fig. 235.)
II. Muckross; M[illegible]w; Lower Lake of Killarney.

7. G. acuminatum, *Ehrenb.* (*W. Sm. l. c.* fig. 238.)
I. Near Westport; Baheh, Moher, Shannacloontippen, Nacoogarrow, Shindilla, and Derryclare Loughs; Lakes, Clifden to Roundstone, and near Recess; Roundstone; Lakes E. of Lough Bofin.—II. Lough Guitane; Torc Mt.; near Lough Brin; Mallow; Clogerheen; 8 m. S. of Kenmare.

8. G. olivaceum, *Kuetz.* (*W. Sm. l. c.* p. 80, tab. 29. fig. 244.)
I. Roundstone; Nabincka Lough; Baheh Loughs.—II. Carrantuohill.

9. Gomphonema intricatum, *Kuetz.* (*W. Sm. Brit. Diat.* i. tab. 29. fig. 241.)

I. Near Westport; Baheh Loughs; Roundstone; Ballynahinch.—II. Torc Mt.; Muckross; Lough Guitane; near Lough Brin.

1. Meridion circulare, *Ag.* (*W. Sm. l. c.* p. 6, tab. 32. fig. 277.)

II. Lower Lake of Killarney.

2. M. constrictum, *Ralfs.* (*W. Sm. l. c.* tab. 32. fig. 278.)

II. Carrantuohill.

1. Tabellaria flocculosa, *Kuetz.* (*W. Sm. l. c.* p. 45, tab. 43. fig. 316.)

I. Glendalough; near Westport; Moher, Nacoogarrow, Nabincka, Derryclare, Shindilla, Creggan, and Baheh Loughs; near Leenane; Roundstone.—II. Lough Guitane; Upper and Lower Lakes of Killarney; Torc Mt.; Carrantuohill; Glen Caragh; Castletown; Cloonee Lough; 8 m. S. of Kenmare.

2. T. fenestrata, *Kuetz.* (*W. Sm. l. c.* fig. 317.)

I. Near Westport; near Oughterard; Glendalough; Lakes near Recess, and from Clifden to Roundstone; Athry, Nabincka, Moher, Baheh, and Derryclare Loughs; Ballynahinch; Lough Shindilla; Nacoogarrow and Arderry Loughs; Roundstone.—II. Lough Guitane; Torc Mt.; Sugar Loaf Mt.; Muckross; Lower Lake of Killarney; Cloonee Lough; Glengarriff; Adrigole.

EXPLANATION OF THE PLATES.

a, a', a''	=	cellula vel semicellula a fronte visa.
b, b'	=	„ „ vertice „
c	=	„ „ latere „
d	=	„ „ basi „
e, e'	=	zygospora (cum vel sine semicellulis residuis).

Plate XVIII.

Fig. 1. *Œdogonium platygnum*, Wittr., forma *major*, West. 400/1.
2. „ *suecicum*, Wittr. 400/1.
3. „ *pilosporum*, West. 625/1.
4–5. *Zygnema leiospermum*, De Bary, forma *megaspora*, West. 400/1.

PLATE XVIII. (*continued*).

Fig. 6. *Botryococcus calcareus*, West. 400/1.
7. *Scenedesmus denticulatus*, Lagerh., var. *lineatus*, West. *a*, 400/1 ; *a'* et *a''*, 625/1.
8. *Anabæna* (*Sphærozyga*) *orthogona*, West. 400/1.
9. *Aphanocapsa Grevillei*, Rabh., var. *microgranula*, West. 600/1.
10-12. *Œdogonium londinense*, Wittr., var. *compressum*, West. 400/1.
13. *Chlorococcum gigas*, Grun., var. *maximum*, West. 400/1.
14. *Acanthococcus* sp. 400/1.
15. *Polyedrium tetraædricum*, Naeg. 400/1.
16. *Closterium moniliferum*, Ehrnb. (c. *Chytridio*).
17. *Mougeotia elegantula*, Wittr., forma *microspora*, West. 400/1.

PLATE XIX.

Fig. 1. *Sphærozosma Aubertianum*, West. 400/1.
2. *Spondylosium tetragonum*, West. 400/1.
3. „ *pulchrum*, Arch., var. *triquetrum*, Lund. 400/1.
4. Forsan semicellulæ juveniles duæ *Cosmarii* abnormalis in stato divisionis. 625/1.
5. *Docidium dilatatum* (Cleve), Lund. 400/1.
6. „ „ „ „ forma. 400/1.
7. „ „ „ „ var. *subundulatum*, West. 400/1.
8–10. *Pleurotænium coronatum*, Rabh. 400/1.
11. „ „ „ var. *fluctuatum*, West. 400/1.
12. „ „ „ var. *robustum*, West. 400/1.
13. *Closterium Pritchardianum*, Arch., var. *minus*, West. 400/1.
14. „ *toxon*, West. *a*, 600/1 ; *a'* et *a''*, 400/1.
15. „ *gracile*, Bréb., forma *gracillima*, West. 400/1.
16. „ *subtile*, Bréb., forma. 600/1.
17. *Penium exiguum*, West. *a* et *a''*, 600/1 ; *a'*, 400/1.
18. „ „ „ *a*, 600/1 ; *a'*, *a''*, et *b*, 400/1.
19. „ *adelochondrum*, Elfv. 400/1.

PLATE XX.

Fig. 1. *Penium minutum*, Cleve, var. *crassum*, West. 400/1.
2. „ „ „ „ „ forma *punctata*, West. 400/1.
3. „ „ „ „ „ forma *inflata*, West. 400/1.
4. „ „ „ var. *undulatum*, West. 400/1.
5. *Cylindrocystis diplospora*, Lund, **major*, West. 400/1.
6. *Mesotænium De-Greyii*, Turn., var. *breve*, West. 400/1.
7. *Tetmemorus granulatus*, Ralfs, var. *attenuatus*, West. 400/1.
8. *Spirotænia bispiralis*, West. 400/1.
9. *Micrasterias pinnatifida*, Ralfs, forma. 400/1.
10. „ *papillifera*, Bréb., var. *glabra*, Nord., forma *inflata*, West. 400/1.

PLATE XX. (*continued*).

Fig. 11. *Euastrum verrucosum*, Ehrnb., var. *coarctatum*, Delp., forma. 400/1.
12. „ *elegans*, Kuetz., forma. 625/1.
13. „ *pyramidatum*, West. 400/1.
14. „ *binale*, Ralfs, forma *hians*, West. 600/1.
15. „ „ „ **subelobatum*, West. 400/1.
16. „ *crassangulatum*, Boerg., var. *ornatum*, West. 400/1.
17. „ *denticulatum*, Gay, var. *granulatum*, West. 600/1.
18. „ *Turnerii*, West. 400/1.
19. *Cosmarium tatricum*, Racib., var. *sphæruliferum*, West. 400/1.
20. „ *eductum*, Roy et Biss., var. *angustatum*, West. 625/1.
21. „ *pseudopyramidatum*, Lund, forma *subrectangularis*, West. 400/1.
22–23. „ *succisum*, West. 400/1.
24. „ *pygmæum*, Arch. 400/1.
25. „ *tenue*, Arch. 400/1.

PLATE XXI.

Fig. 1. *Cosmarium venustum*, Rabh., var. *hypohexagonum*, West. 400/1.
2. „ *perpusillum*, West. 600/1.
3. „ *Regnesii*, Reinsch, var. *tritum*, 600/1.
4. „ *Subdanicum*, West. *a*, 600/1 ; *b* et *c*, 400/1.
5. „ *Nuttallii*, West. 600/1.
6. „ *Brebissonii*, Menegh., forma *erosa*, West. 400/1.
7. „ *conspersum*, Ralfs, var. *subrotundatum*, West. *a*, 600/1 ; *a'* et *b*, 400/1.
8. „ *sphæroideum*, West. *a*, *b*, et *c*, 400/1 ; *a'*, 600/1.
9. „ *subpunctulatum*, Nord., var. *Boergesenii*, West. 625/1.
10. „ *Arnellii*, Boldt, forma *compressa*, West. 625/1.
11. „ *synthlibomenum*, West. 625/1.
12. „ *Botrytis* (Bory), Menegh., var. *mediolæve*, West. *a*, *b*, et *c*, 400/1 ; *a'*, 600/1.
13. „ *confusum*, Cooke, **ambiguum*, West. *a*, *b*, et *c*, 600/1 ; *a'*, 400/1.
14. „ *Boeckii*, Wille, **bipapillatum*, West. 400/1.
15. „ *isthmium*, West, forma *hibernicum*, West. 400/1.
16. „ *connatum*, Bréb., var. *truncatum*, West. 400/1.
17. „ *pseudoconnatum*, Nord., var. *constrictum*, West. 400/1.
18. „ *obcuneatum*, West. *a*, 600/1 ; *e*, 400/1.
19. „ *Hibernicum*, West. 400/1.

PLATE XXII.

Fig. 1. *Xanthidium armatum*, Bréb., var. *irregularius*, West. 400/1.
2. „ *antilopæum*, Kuetz., forma. 400/1.
3. „ *cristatum*, Bréb., forma *angulatum*, West. 400/1.
4. „ *subhastiferum*, West. 400/1.
5. „ *Smithii*, Arch., var. *collum*, West. 400/1.
6. „ *concinnum*, Arch., var. *Boldtiana*, West. 400/1.

PLATE XXII. (*continued*).

Fig. 7. *Arthrodesmus elegans*, West. 400/1.
8. ,, *bifidus*, Bréb., var. *latodivergens*, West. 400/1.
9. ,, *tenuissimus*, Arch. 400/1.
10. ,, *glaucescens*, Wittr., forma *convexa*, West. 400/1.
11. *Staurastrum dejectum*, Bréb., var. *inflatum*, West. 400/1.
12. ,, *corniculatum*, Lund, var. *spinigerum*, West. 400/1.
13. ,, *curvatum*, West. 400/1.
14. ,, *jaculiferum*, West. 400/1.
15. ,, *O'Mearii*, Arch., var. *minutum*, West. 400/1.
16. ,, *cristatum*, Arch., forma. 625/1.
17. ,, *oligacanthum*, Bréb., var. *incisum*, West. 400/1.
18. ,, *polytrichum*, Perty, forma. 600/1.

PLATE XXIII.

Fig. 1. *Staurastrum megalonotum*, Nord., forma Nord. 400/1.
2. ,, *avicula*, Bréb., var. *verrucosum*, West. 400/1.
3. ,, *spongiosum*, Bréb., var. *perbifidum*, West. 400/1.
4. ,, *subscabrum*, Nord., forma *scabrior*, West. 400/1.
5. ,, *trachygonum*, West. 400/1.
6. ,, *hibernicum*, West. 400/1.
7. ,, *pygmæum*, var. *trilineatum*, West. 400/1.
8. ,, *subpygmæum*, West. 400/1.
9. ,, *amœnum*, Hilse, var. *brasiliense*, Boerg. 400/1.
10. ,, *arcuatum*, Nord., var. *guitanense*, West. 400/1.
11. ,, *gracile*, Ralfs, **bulbosum*, West. 400/1.
12. ,, *paradoxum*, Meyen, forma *parva*, West. 400/1.
13. ,, ,, ,, var. *nodulosum*, West. 400/1.
14. ,, *natator*, West. 400/1.
15. ,, *Archerii*, West. 400/1.

PLATE XXIV.

Fig. 1. *Staurastrum Pseudosebaldi*, Wille, **duacense*, West. 400/1.
2. ,, *anatinum*, Cooke et Wills., var. *truncatum*, West. 400/1.
3. ,, ,, ,, ,, **biradiatum*, West. 400/1.
4. ,, *arachnoides*, West. 400/1.
5. ,, *teliferum*, Ralfs (cum zygosp.). 400/1.
6. ,, ,, ,, forma *obtusa*, West. 400/1.
7. *Euastrum pectinatum*, Bréb. (cum zygosp.). 400/1.
8. *Mesotænium chlamydosporum*, De Bary (cum zygosp.). 400/1.
9. *Cosmarium plicatum*, Reinsch, var. *hibernicum*, West. 400/1.
10. ,, *elegantissimum*, Lund., forma *minor*, West. 400/1.
11. *Arthrodesmus Incus*, Hass. (cum zygosp.). 400/1.
12. *Pleurotænium tridentulum*, nob., var. *capitatum*, West. 625/1.
13. *Euastrum scitum*, West. *a–c*, 400/1 ; *a'*, 625/1.
14. *Staurastrum minutissimum*, Reinsch, var. *constrictum*, West. 625/1.
15. *Cosmarium obliquum*, Nord., var. *trigonum*, West. 400/1.

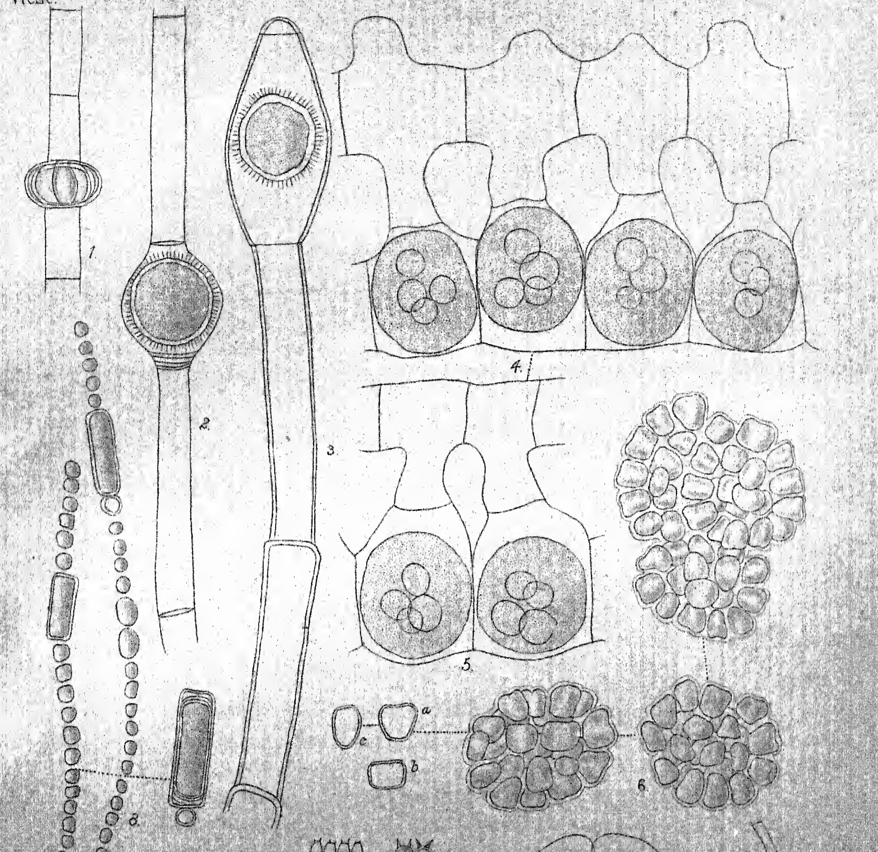
PLATE XXIV. (*continued*).

Fig. 16. *Staurastrum trachynotum*, West., var. *annulatum*, West. 400/1.
17. *Xanthidium apiculiferum*, West. 625/1.
18. *Cosmarium Meneghinii*, Bréb., var. *Wollei*, Lagerh. (forma monstrosa). 400/1.
19. *Arthrodesmus triangularis*, Lagerh., forma. 400/1.
20. *Penium suboctangulare*, West. 400/1.
21. *Cosmarium subprotumidum*, Nord., forma. 625/1.
22. „ *obsoletum*, Reinsch, var. *angustatum*, West. 400/1.
23. „ *venustum*, Arch., var. *hypohexagorum*, West, f. *incrassata*, West. 400/1.
24. „ *arctoum*, Nord., f. *minor*, West. 400/1.
25. „ *cucurbita*, Bréb., f. *major*, West. 400/1.
26. *Zygogonium momoniense*, West. 400/1.

Supplementary Note on a new Fossil Plant,
by THOMAS HICK, B.A., B.Sc. (*ante*, p. 86).

To avoid any possible confusion with *Tylophora*, R. Br., Mr. Hick proposes to withdraw the name given on p. 101, and to substitute for it *Xenophyton*, from ξένος, strange, and φυτὸν, plant, to indicate the curious structure of the plant; the species will therefore be henceforth known as *X. radiculosa*.

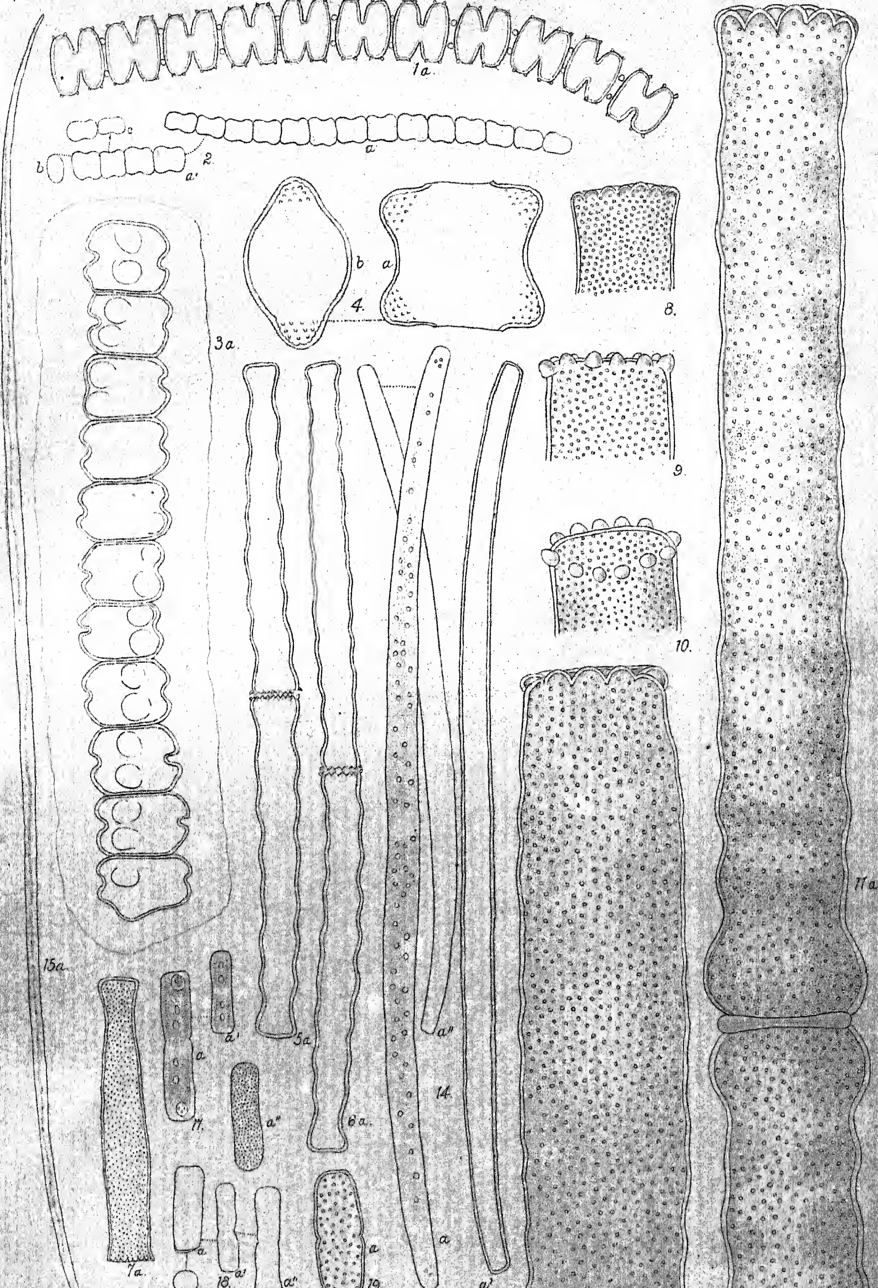
West.



G.S. West ad nat. del. J. Carter sc.

FRESHWATER ALGÆ OF IRELAND

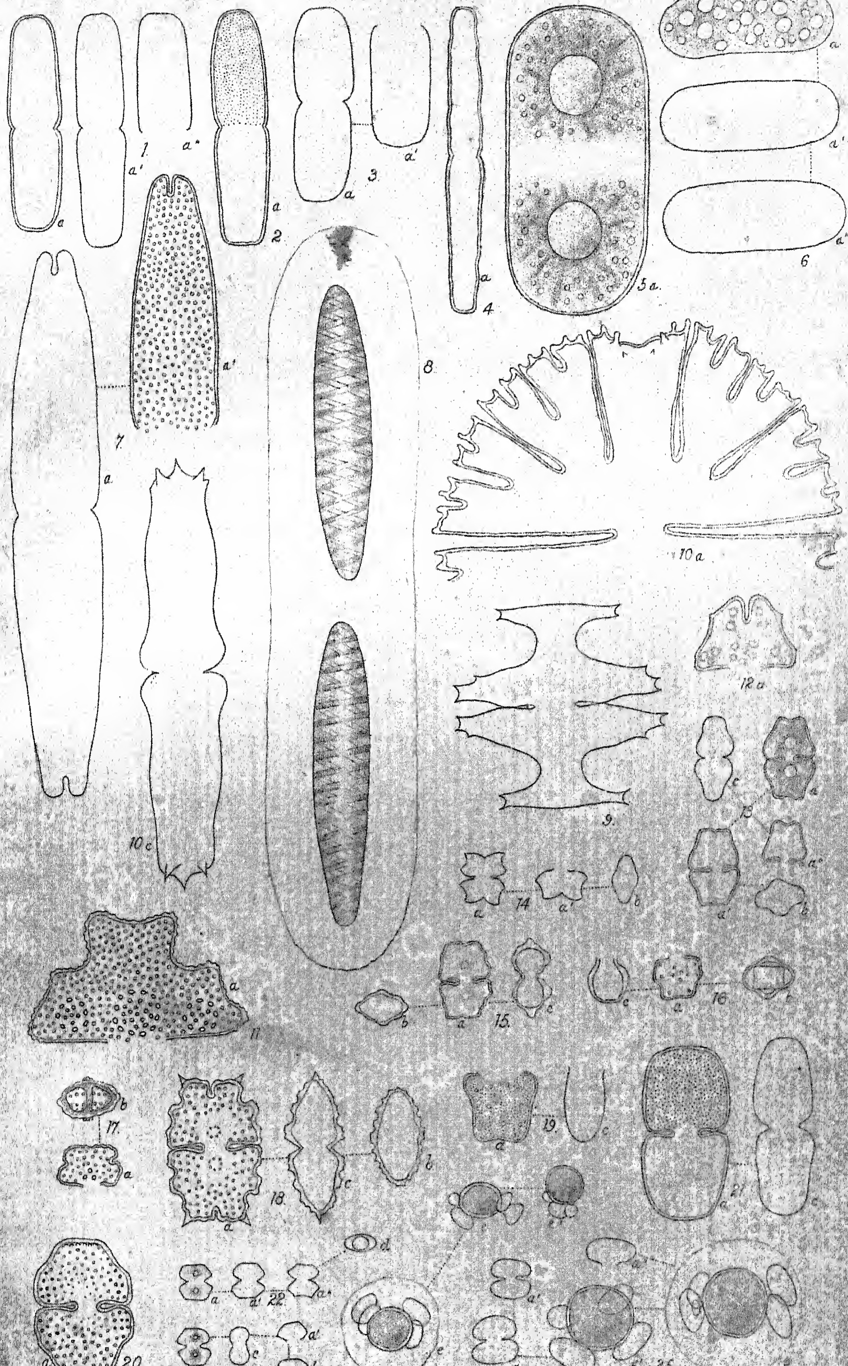
Mintern Bros. imp.



G.S. West, ad nat del. J. Carter sc.

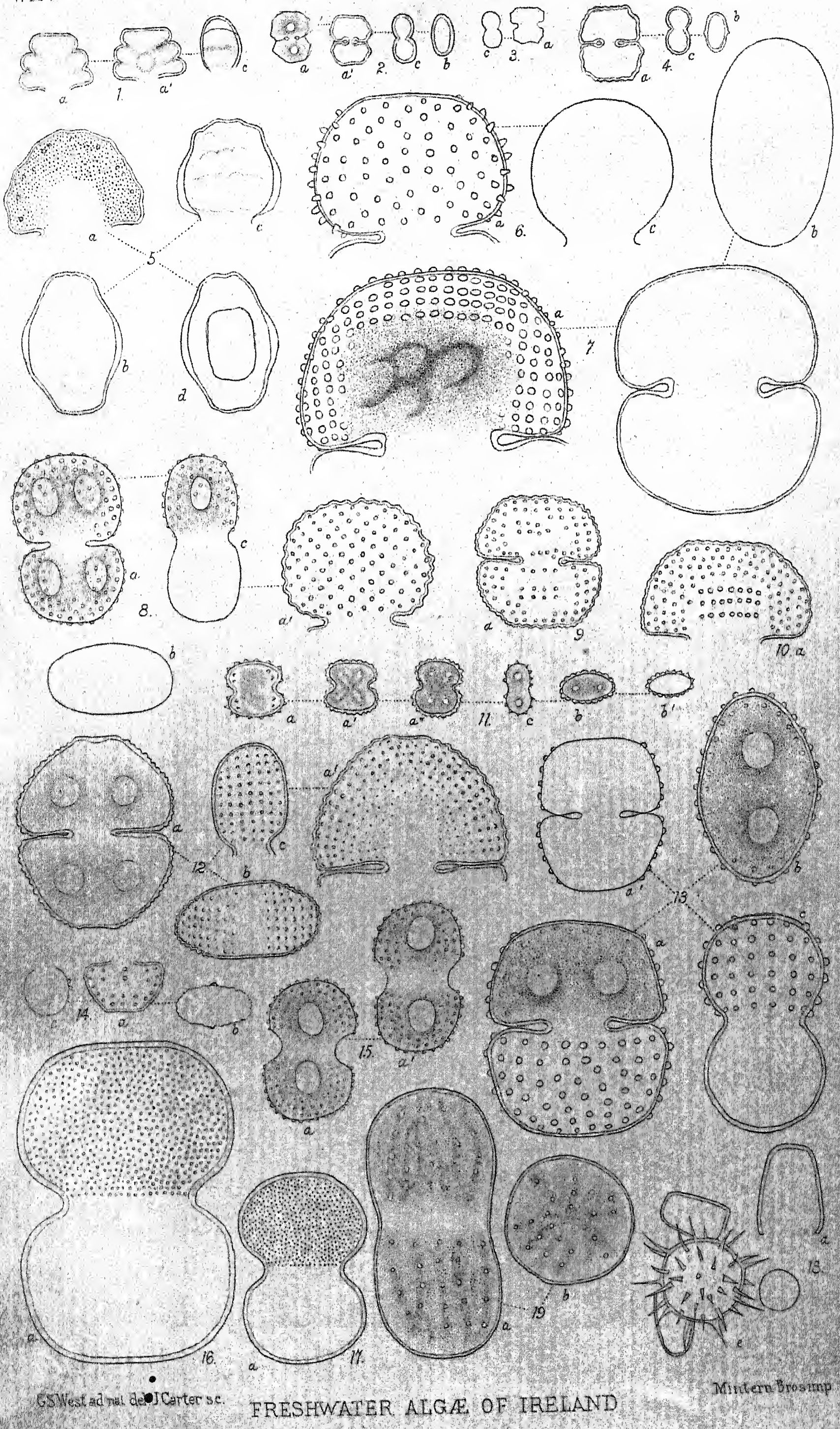
FRESHWATER ALGÆ OF IRELAND

Mintern Bros imp.



G. S. West ad nat. del. Carter sc. Mintern Bros imp.

FRESHWATER ALGÆ OF IRELAND



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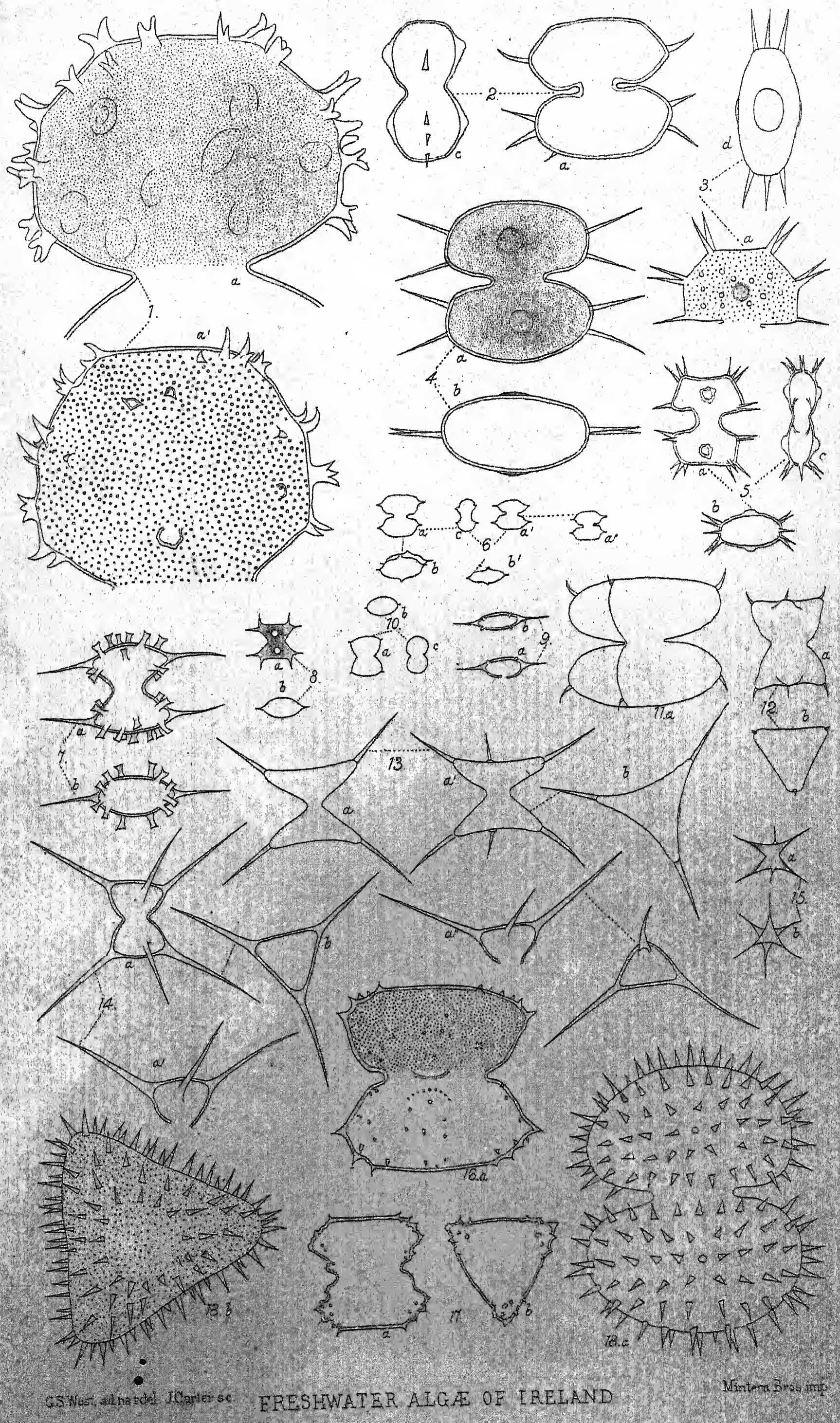

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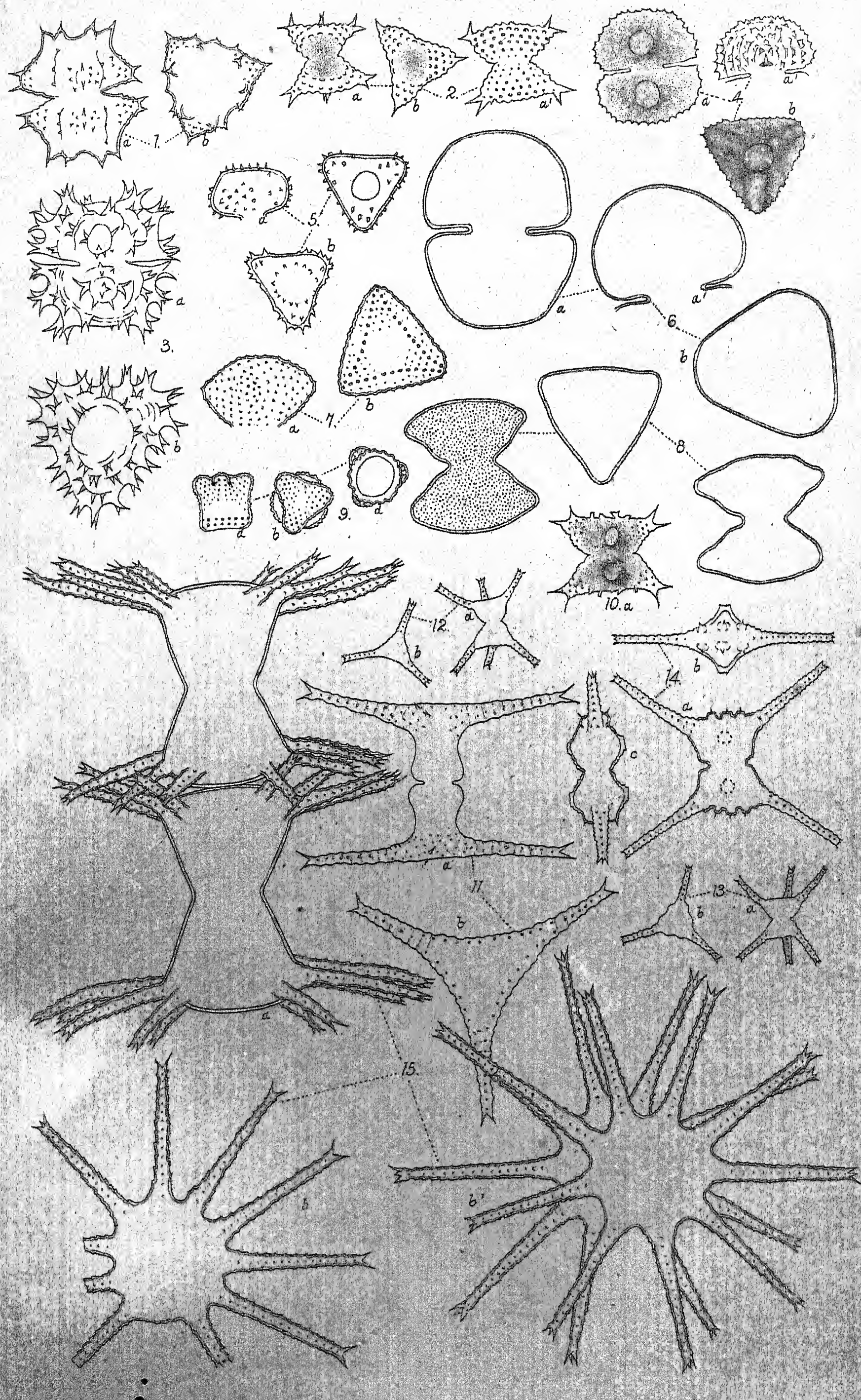

G.S. West ad nat del. J. Carter sc.

FRESHWATER ALGÆ OF IRELAND

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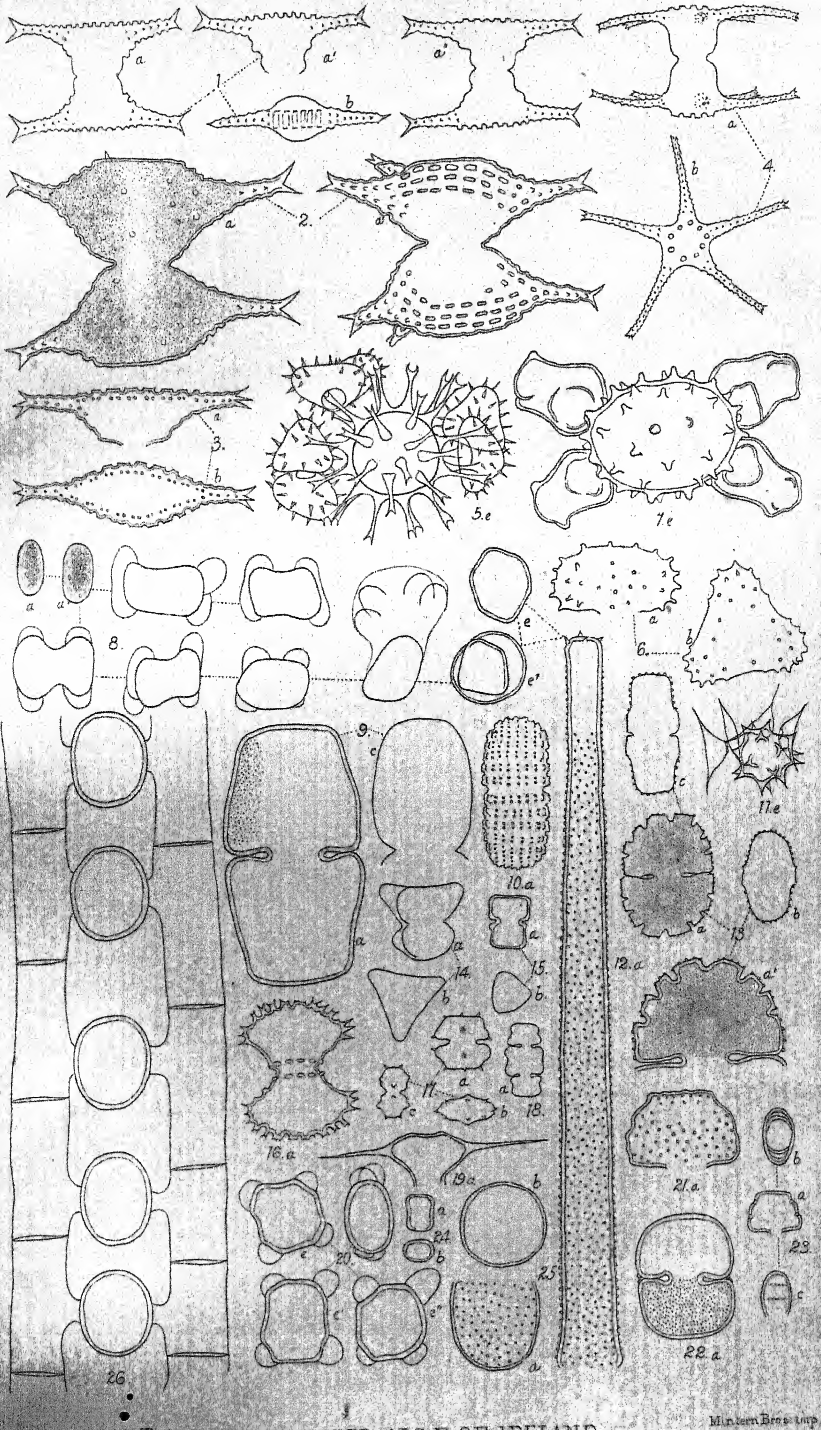


G.S.West ad nat del. J.Carter sc. FRESHWATER ALGÆ OF IRELAND Mintern Bros. imp.

LICHENES MANIPURENSES, a cl. Dr. G. Watt circa Manipur, ad limites orientales Indiæ Orientalis 1881–1882, lecti*, auctore Dr. J. MÜLLER. (Communicated by W. T. THISELTON DYER, C.M.G., F.R.S., F.L.S.)

[Read 21st January, 1892.]

Trib. CLADONIEÆ.

1. CLADONIA FURCATA, v. ASPERATA, *Müll. Arg. in Flora*, 1882, p. 295; ad terram.

2. C. DEGENERANS, v. TRACHYNA, *Floerke, Clad.* p. 44; ad terram.

3. C. VERTICILLATA, *Floerke, Clad.* p. 26; ad terram, n. 5089.

Trib. USNEEÆ.

4. USNEA RETICULATA, *Hoffm. Deutschl. Flora*, p. 135; n. 6944.

5. U. PLICATA, *Hoffm. D. Flora*, p. 132; n. 7102.

6. U. BARBATA, v. COMOSA, *Wainio, Etud.* p. 3.—Usnea barbata, v. aspera, *Müll. Arg. Revis. Lich. Mey.* n. 2; nn. 6943, 6954.

—— , v. ASPERRIMA, *Müll. Arg. in Flora*, 1882, p. 299; n. 6943 pr. p.

—— , v. DENSIROSTRA, *Müll. Arg. l. c.* 1881, p. 83.

Trib. RAMALINEÆ.

7. RAMALINA CALICARIS, *Fr., Nyl. Recogn. Ramal.* p. 33; nn. 6942, 6952, 6953, 6019.

—— , v. SUBAMPLIATA, *Nyl. Recogn. Ram.* p. 34.

8. NEPHROMOPSIS STRACHEYI, *Müll. Arg. in Flora*, 1891, p. 374.—Cetraria Stracheyi, *Babingt.*—Platysma Stracheyi, *Nyl. Syn.* p. 305. Frequens ad terram in montibus apertis; nn. 6717, 6900.

9. CETRARIA HYPOTRACHYNA, *Müll. Arg. in Flora*, 1891, p. 373.

* Species omnes, ubi aliter non statuitur, ad cortices lectæ sunt.

10. CETRARIA WALLICHIANA, *Müll. Arg. in Flora*, 1888, p. 138. —Sticta Wallichiana, *Tayl. in Hook. Journ. Bot.* 1847, p. 177.

11. C. THOMSONI, *Müll. Arg. in Flora*, 1891, p. 373.—Platysma Thomsoni, *Stirt. in Proc. Phil. Soc. Glasg.* xi. 1878–79, p. 321.

12. C. SANGUINEA, *Schaer.*, v. DISSECTA, *Müll. Arg.*; n. 6396.

Trib. PARMELIEÆ.

13. STICTINA RETIGERA, *Müll. Arg. in Flora*, 1878, p. 484; nn. 6689, 6899.

14. STICTA PULMONACEA, v. HYPOMELA, *Del. Stict.* p. 144; n. 6367.

15. S. PLATYPHYLLA.—Sticta damæcornis *platyphylla, *Nyl. Syn.* p. 357; n. 6947.

16. S. HERBACEA, *Del. Stict.* p. 132; n. 6395.

17. S. ADPRESSA, *Müll. Arg. in Flora*, 1891, p. 375; n. 6951.

18. PARMELIA LATISSIMA, *Fée*, f. ISIDIOSA, *Müll. Arg. L. B.* n. 190.

— —, f. SOREDIATA, *Nyl. Syn.* p. 380.

19. P. CETRATA, v. SOREDIIFERA, *Wain. Etud.* i. p. 40.

20. P. LÆVIGATA, *Ach. Syn.* p. 212.

21. P. KAMTSCHADALIS, *Eschw. Bras.* p. 202.

22. P. ZOLLINGERI, *Hepp in Zolling. Syst. Verzeichn.* p. 6.

23. P. WALLICHIANA, *Tayl. in Hook. Journ. Bot.* 1847, p. 176; *Müll. Arg. in Flora*, 1888, p. 203.

24. P. TILIACEA, *Ach. Meth.* p. 215.

25. P. WATTIANA, *Müll. Arg. in Flora*, 1891, p. 379.

26. ANAPTYCHIA SPECIOSA, v. HYPOLEUCA (Physcia speciosa v. hypoleuca, *Nyl. Syn.* p. 417), f. SOREDIIFERA.

27. PHYSCIA SETOSA, *Nyl. Syn.* p. 429, v. ENDOCOCCINEA, *Müll. Arg. in Flora*, 1891, p. 376.

28. P. PICTA, v. SOREDIATA, *Müll. Arg. Lich. Afr. occid.* n. 12.

Trib. PYXINEÆ.

29. PYXINE ENDOCHRYSINA, *Nyl. Lich. Japon.* p. 34.

30. Pyxine Cocoës, *Nyl. Lich. exot. Polynes., in Ann. Sc. Nat.* sér. 4, xi. 1859, p. 239.

31. P. retirugella, *Nyl. l. c.* p. 240.

Trib. Placodieæ.

32. Placodium (§ Acarospora) indicum, *Müll. Arg.*; thallus areolato-squamulosus, badio-fuscus; squamulæ apotheciis 2–3plo minores, parce crenulatæ et angulosæ, sublæves v. demum rugulosæ, planæ; apothecia $\frac{2}{3}$–$\frac{4}{5}$ mm. lata, adpresso-sessilia, omnino emersa, margine thallino cum thallo concolore et tenui cincta; margo integer, intus linea zeorina obscuriore et cum disco concolore magisque prominente præditus; discus nigro-fuscus et nudus, planus.—Species est propria, sed sporæ evolutæ non aderant, ex habitu juxta *Pl. subglobosum*, Müll. Arg. Lich. Argentin. n. 23, locanda.—Saxicola in rivulis montium supra Manipur, alt. 6000–10,000 ped., parcissime lecta.

Trib. Psoreæ.

33. Psora parvifolia, *Müll. Arg.*—Lecidea parvifolia, *Pers. in Gaudich. Bot. Voy. Uran.* p. 192; sterilis tantum lecta, sed in specim. varietatis sequentis apothecium unicum sporigerum missum fecit.

— —, v. subgranulosa.—Lecidea parvifolia, v. subgranulosa, *Tuckerm. in Proc. Am. Acad.* vi. (1864) p. 273.

34. P. manipurensis, *Müll. Arg.*; thalli squamulæ glauco-albæ, depresso-granuliformes, $\frac{1}{10}$–$\frac{2}{10}$ mm. latæ, subadpressæ, orbiculares et oblongatæ, plerumque integræ, hinc inde crenatæ, margine subtilissime albo-fimbriatæ, hypothallus parum distinctus; apothecia $\frac{1}{4}$–$\frac{1}{3}$ mm. lata, sessilia, crassiuscula, juniora olivaceo-fusca et crasso-marginata, demum nigro-fusca et cito immarginata, mox convexa, opaca, intus obscura; hypothecium flavo-fuscum, crassum; sporæ 8næ, cylindrico-ellipsoideæ, 8–9 μ longæ et 3 μ latæ.—Thallus ut in *Ps. pyrrhomelæna* (*Lecidea pyrrhomelæna*, Tuckerm. in Proc. Am. Acad. v. 1862, p. 419), sed hypothallus non fusco-prædominans, apothecia non gregatim approximata nec persistenter marginata et hypothecium aliud. Inter hanc et *Ps. chlorophæam*, Müll. Arg. in Flora, 1887, p. 320, locanda est.

Trib. Lecanoreæ.

35. Lecanora granifera, *Ach. Syn.* p. 163.

36. Lecanora atra, *Ach.*, v. americana, *Fée, Suppl.* p. 110; *Müll. Arg. Revisio Lich. Féean.* p. 18.

37. L. cenisia, *Ach. Univ.* p. 361; saxicola secus rivulos supra Manipur, alt. 6000–10,000 ped.

38. L. subfusca, *Ach.*, v. argentata, *Th. M. Fries, Lich. Scand.* ii. p. 239.

— —, v. coilocarpa, *Ach. Univ.* p. 393.

— —, v. glabrata, *Ach. Univ.* p. 393.

— —, v. lainea, *Fr. L. Europ.* p. 140; saxicola in rivulis montium, alt. 6000–10,000 ped.

— —, v. distans, *Nyl. Scand.* p. 160.

— —, v. chlarona, *Nyl. Scand.* p. 160.

— —, v. cinereo-carnea, *Tuck. in C. Wright, Lich. Cub.* n. 118, c. syn.

39. L. albella, *Ach. Univ.* p. 369.

40. L. emergens, *Müll. Arg.*; thallus pallido-albus, tenuissimus, minute granuloso-rugulosus, continuus, linea latiuscula cæruleo-nigricante cinctus; apothecia $\frac{3}{4}$–1 mm. lata, tenuia, plana, obsolete tantum e thallo emergentia, margine tenui thallino fere discreto-granulari coronata; discus obscure fuscus, nudus; epithecium fuscidulum, reliquæ partes laminæ cum hypothecio hyalinæ; sporæ 8næ, 12–15 μ longæ, $7\frac{1}{2}$–$8\frac{1}{2}$ μ latæ.—Partes interiores ut in *L. subfusca*, Ach., sed apothecia immersa et margo peculiaris, quasi serie granulorum thallinorum formatus speciem bene distinguunt. Prope Africanam *L. fibrosam*, Müll. Arg. in Flora, 1888, p. 140, inserenda est (parce lecta).

41. L. pallescens, *Fr. L. Europ.* p. 132.

42. Lecania (§ Maronea) melanocarpa, *Müll. Arg. Lich. Noum.* p. 3.

43. L. (§ Hæmatomma) punicea, *Müll. Arg. in Flora*, 1879, p. 294.

— —, v. accolens.—Lecanora punicea, v. accolens, *Stirt. Veg. Paras. on Tea Plant*, p. 4.

44. Rinodina exigua, *Mass. Ric.* p. 15.

45. Urceolaria (§ Limboria) actinostoma, *Schaer. Enum.* p. 87; saxicola supra Manipur, alt. 6000–10,000 ped.

46. Pertusaria velata, *Nyl. Scand.* p. 179.

— —, f. variolosa, *Müll. Arg. Revis. Lich. Féean.* n. 4.

47. PERTUSARIA MULTIPUNCTATA, *Nyl. Scand.* p. 179.

48. P. PERTUSELLA, *Müll. Arg. in Flora*, 1884, p. 283; male evoluta, intus sæpius degenerato-nigrata, parce lecta.

49. P. MELALEUCA, *Duby, Bot. gall.* p. 673; *Müll. Arg. in Flora*, 1884, p. 287; parcissime lecta.

— —, v. TETRAMERA, *Müll. Arg. l. c.*; parcissime missa.

50. P. RIGIDA, *Müll. Arg.*; thallus albido-flavicans, tenuis, rugulosus, in ipsa superficie lævigatus; verrucæ $1\frac{1}{2}$–2 mm. latæ, hemisphæricæ, ambitu regulares et obtuse gibboso-irregulares, cum thallo rigido-firmæ, sæpe varie confluentes, primum rotundato-obtusæ, dein vertice paullo depressæ, superficie cum thallo firmæ, vertice subconfertim pauciostiolatæ; ostiola carneo-fusca, majuscula, orbicularia et pro parte versus centrum verrucæ convergenti-rimularia; sporæ in ascis 4–8næ, circ. 75 μ longæ et 35 μ latæ, intus læves.—Prope *P. melaleucam*, Duby, locanda, sed longe major, coriaceo-rigida et magis flavicans.

51. P. LEIOPLACA, v. TURGIDA, *Müll. Arg. in Flora*, 1884, p. 305.

— —, v. OCTOSPORA, *Nyl. Scand.* p. 182.

52. P. WATTIANA, *Müll. Arg.*; thallus glaucus, tenuissimus, lævis; verrucæ $\frac{1}{2}$ mm. latæ, regulares, v. confluentim majores et magis irregulares, hemisphæricæ, magis compositæ subtruncatæ, pluriostiolatæ; ostiola nigra, haud immersa, nec emersa; sporæ 2næ, circ. 110–120 μ longæ, elongato-ellipsoideæ, intus valide costulatæ.—Proxime accedit ad *P. trypetheliiformem*, Nyl., sed thallus lævigatus, magis glaucus ut in *P. Moffatiana*, Müll. Arg., ostiola majora et demum ab ambabus sporis intus insigniter costulatis differt.

— —, f. FULVESCENS, thallus decolorando fulvescens.

Trib. LECIDEEÆ.

53. LECIDEA (§ BIATORELLA) CONSPERSA, *Fée, Ess.* p. 108, t. 27. fig. 4; *Müll. Arg. Revis. Lich. Féean.* p. 8.

54. L. (§ BIATORA) PERMUTABILIS, *Müll. Arg.*; thallus griseo-pallens v. griseo-albidus, tenuissimus, fere maculiformis, lævis v. demum obsolete rugulosus; apothecia diametro $\frac{1}{2}$ mm. æquantia et commiscue 2–3plo minora, semper planiuscula, fusca v. etiam nigrescenti-fusca et nuda, ad peripheriam paullo translucentia, tenuiter marginata; epithecium fulvo-fuscescens, reliqua laminæ hyalina; paraphyses conglutinatæ; asci obovoidei v. oblongo-

obovoidei, apice valide pachydermei, 8-spori; sporæ ovoideæ, 8–12 μ longæ et 6–7 μ latæ.—Similis Brasiliensi *L. fuscellæ*, Müll. Arg., sed thallus non granularis, asci alii et sporæ minores. A *L. mutabili*, Fée, jam apotheciis magis regularibus, firmioribus, marginatis et semper subplanis et dein sporis minoribus recedit.

55. Lecidea (§ Biatora) russula, *Ach.*, v. leprosa, *Nyl. Enum.* p. 120.

56. L. (§ Biatora) aurigera, *Fée, Ess.* p. 106, t. 28. fig. 1; *Müll. Arg. Revis. Lich. Féean.* p. 5.

57. L. (§ Lecidella) parasema, *Ach.*, v. microcarpa, *Müll. Arg.*; thallus albidus, obsolete rugulosus; apothecia ¼ mm. lata, persistenter plana, marginata, nigra, intus nigro-obscurata; lamina e cupreo-fuscidulo demum undique hyalina.

58. L. (§ Eulecidea) albocærulescens, *Ach. Meth.* p. 52; saxicola in rivulis montium supra Manipur (apotheciorum disco sæpius denudato-nigro).

59. Patellaria (§ Psorothecium) leptocheiloides, *Müll. Arg. in Flora*, 1885, p. 509.—Sporæ ut in diversa *Patellaria anaglyptica* (*Lecidea anaglyptica*, Krempelh. Lich. Warm. p. 385); a proxima *Patellaria leptocheila*, Müll. Arg., recedit hypothecio crasso, fulvo- v. cupreo-nigricante s. apotheciis intus profunde nigris.

60. P. (§ Bombyliospora) leprolyta, *Müll. Arg. in Flora*, 1880, p. 41.

61. P. (§ Bacidia) americana, *Müll. Arg. Revis. Lich. Féean.* p. 7, var. lividio-nigricans; apothecia ex albido mox livido-nigricantia. Reliqua bene conveniunt.

62. P. (§ Bacidia) convexula, *Müll. Arg.*; thallus albidus, tenuissimus, e verniceo-lævi obsolete furfurascens, subobsoletus; apothecia $\frac{1}{3}$–$\frac{2}{3}$ (–$\frac{4}{5}$) mm. lata, rufo-carnea, subpellucentia, novella crassiuscule, evoluta autem tenuiter et obsolete marginata, e plano mox convexa et rufo-obscurata, nuda, intus pallida lamina præter epithecium paullo obscuratum subhyalina; sporæ 35–42 μ longæ, $1\frac{1}{2}$–2 μ latæ, bacillares, utrinque obtusæ, 3–5-septatæ.—Prope subsimiles *P. hosthelioidem*, Müll. Arg., et *P. rufescentem*, Müll. Arg., locanda est, extus fere *P. subpellucidam*,

Müll. Arg., referens, ubi autem sporæ crassiores et multo magis divisæ sunt.

63. Patellaria (§ Bacidia) rufescens, *Müll. Arg. in Flora*, 1884, p. 467; parce lecta.

64. P. (§ Bacidia) luteola, *Müll. Arg. in Flora*, 1885, p. 532.

65. Heterothecium vulpinum, *Tuck. Lich. Calif.* p. 31, in not.

66. Buellia parasema, v. disciformis, *Th. M. Fries, Scand.* p. 590; corticola.

67. B. stellulata, *Mudd, Man.* p. 216; saxicola in cavernosis montium supra Manipur.

Trib. Graphideæ.

68. Dirina byssiseda, *Müll. Arg.*; thallus e virente v. flavescente albus, tenuis, ecorticatus, superficie hyphis subtiliter tomentosus, margine zona fusco-nigricante byssina cinctus; gonidia chroolepoidea, articuli 6–8 μ lati; apothecia $\frac{1}{2}$–1 mm. lata, laxe sessilia, basi coarctata, lecanorina et plana, ambitu regulariter orbicularia, haud undulata; margo thallinus obsolete tomentellus, junior discum obtegens, demum superficie firmus; discus fusco-niger et nudus; margo proprius interior occlusus, apicem laminæ haud attingens; epithecium rufo-nigricans; lamina hyalina; hypothecium nigrum valde incrassatum; paraphyses haud convexæ, simplices aut bifurcatæ, superne fusco-nigricantes; sporæ (juniores tantum visæ) 25 μ longæ, subrectæ, tenuiter bacillares, 4-loculares.—Habitu ad *Platygrapham dilatatam*, Nyl., accedit, at apothecia omnino regularia et paraphyses non intricato-connexæ.

69. Platygrapha gregantula, *Müll. Arg.*; thallus argillaceo-albidus, tenuissimus, lævis, subfarinulentus; apothecia $\frac{1}{4}$–$\frac{1}{3}$ mm. lata, adpresso-sessilia, orbicularia v. obsolete obtuse angulosa, margine thallino prominente obsolete crenulato et interiore nigro tenui et emergente prædita; discus planus, cæsio-niger; epithecium et hypothecium angustam nigro-fusca; sporæ in ascis 8næ, hyalinæ, (6–)8-loculares, 45–50 μ longæ et 5–6 μ latæ, utrinque acute acuminatæ, sigmoideo-curvatæ.—Est habitu et characteribus proxima *Pl. byssisedæ*, Müll. Arg. Graphid. Féean. p. 15, et *Pl. lecanoroidi*, Nyl. Lich. exot. Peruv. p. 229, et

Müll. Arg. l. c., at margo interior niger et prominens, hypothecium angustum, nec valde profundo-incrassatum, et sporæ crassiores quam in priore, magis acuminatæ quam in posteriore recedunt.

70. Platygrapha cinerea, *Müll. Arg.*; thallus cinereus, tenuis, lævis, rimulosus; apothecia innato-adpressa, circ. $\frac{1}{3}$ mm. lata, conferta, sæpe mutua pressione angulosa, crasse thallino-marginata, margo crispulo-crenatus, interior niger demum emergens; epithecium et hypothecium angustum fuscidula; perithecium intus olivaceo-fuscum; sporæ 8næ, 50–55 μ longæ, $3\frac{1}{2}$–$4\frac{1}{2}$ μ latæ, leviter sigmoideæ, utrinque acutæ, 8-loculares.—A proxima *Pl. gregantula* recedit thallo cinereo, hypothecio, sporis tenuioribus.

71. Opegrapha subsulcata, *Müll. Arg.*; thallus macularitenuissimus, cinereo-albidus, lævigatus, zonula latiuscula nigrescente cinctus; lirellæ 1–$2\frac{1}{2}$ mm. longæ, $\frac{1}{4}$–$\frac{1}{3}$ mm. latæ, graciles, lineares, rectæ et varie flexuosæ, utrinque obtusæ, primum lateraliter halone thallino vestitæ, mox dein nudatæ et opaco-nigræ, vertice sulcato-rimales; labia obtusa, integra, demum hinc inde sulcata; perithecium basi completum, nunc ibidem attenuatum; asci oblongo-obovoidei, 8-spori; sporæ 25–30 μ longæ, 7 μ latæ, fusiformes, 8-loculares.—Prope Australiensem *Op. intervenientem*, Müll. Arg., locanda est. Prima fronte cæterum ad *Op. variam* v. *rimalem*, Schær., accedit, sed lirellæ magis elongatæ, flexuosæ, naniores, demum subsulcatæ et sporæ 8-loculares ambitu graciliores sunt.

72. Graphis (§ Aulacographa) striatula, *Nyl. Prodr. Nov. Granat.* p. 77; parce missa.

73. G. (§ Aulacographa) duplicata, *Ach. Syn.* p. 81; frequens.

— —, v. sublævis, *Müll. Arg. Graphid. Féean.* p. 35; frequens.

74. G. (§ Aulacographa) supertecta, *Müll. Arg. Lich. Costaric.* n. 134, *in Bull. Soc. Roy. Bot. Belg.* xxx. p. 77.

75. G. (§ Aulacogramma) rimulosa, *Müll. Arg. Lich. Costaric.* n. 136, var. parallela; lirellæ horizontaliter subparallelæ.

76. G. (§ Aulacogramma) verminosa, *Müll. Arg.*; thallus

argillaceo-albidus, maculari-tenuissimus, lævigatus, margine sensim effusus; lirellæ 1–5 mm. longæ, ½ mm. latæ, subsimplices et subrectæ, adpresso-sessiles v. semi-innatæ, utrinque vulgo acutæ, juniores erumpentes thallino-tectæ, evolutæ, lateraliter thallino-vestitæ et vertice albido-suffusæ; labia crassa, nana, late obtusa et multisulcata; epithecium rimiforme, nigrum; perithecium basi completum, undique fusco-nigrum; sporæ 8næ, 80–150 μ longæ et 7–10 μ latæ, vermiformes, i. e. fere undique æquilatæ, utroque apice late obtusæ, 25–38-loculares.—Species juxta *Gr. substriatulam*, Nyl. in Prodr. Nov. Gran. p. 563 (non ejusd. p. 78), locanda, sporis valde insignita.

77. GRAPHIS (§ AULACOGRAMMA) CONTORTUPLICATA, *Müll. Arg.*; thallus glauco-albidus, tenuissimus, lævis, margine effusus; lirellæ 1–4 mm. longæ, ⅓–½ mm. latæ, subsimplices, serpentino-contortuplicatæ, et tremuloso-flexuosæ, benæ evolutæ, pro latitudine insigniter elatæ, multo altiores quam latæ, sc. a latere compressæ, omnino emersæ et opaco-nigræ; labia arcte conniventia, supra et extus subtiliter multisulcata; perithecium basi crasso-completum, undique nigrum; sporæ in ascis 2–4næ, obtuse fusiformes, 60–95 μ longæ, 9–11 μ latæ, 15–25-loculares.—Juxta Brasiliensem *Gr. flexibilem*, Krempelh. Lich. Glaz. p. 57, inserenda est, a qua recedit lirellis validioribus, magis a latere compressis, nudis, et sporis dein magis divisis.—Copiose.

78. G. (§ EUGRAPHIS) LONGIRAMEA, *Müll. Arg.*; thallus argillaceo-albidus, tenuissimus, lævis, nitidulus, margine effusus; lirellæ magnæ, validiusculæ, 5–18 mm. longæ et ½–⅔ mm. latæ (incluso strato thallino), vage ramosæ, ramis furcatis et hinc inde pedatim ramosis et acuminatis, emergentes, strato thallino crassiusculo tectæ, vertice rimigero demum nudatæ; perithecium nigrum, basi deficiens; labia juniora arcte clausa, demum hiantia; hypothecium hyalinum; asci 6–8-spori; sporæ 55–62 μ longæ, 10–12 μ latæ, obtuse fusiformes, 12–16-loculares.—Prope Australiensem *Gr. crassilabram*, Müll. Arg., locanda est, et habitu fere Borneensem *Graphinam* (§ *Solenographinam*) *ramificantem*, § *Graphidem ramificantem*, Krempelh. Lich. Becc. p. 35, refert.—Copiose.

79. PHÆOGRAPHIS (§ MELANOBASIS) DIVERSA, *Müll. Arg. in Flora*, 1882, p. 336.—Graphis diversa, *Nyl. Lich. exot. Boliv.* p. 227.

80. P. (§ HEMITHECIUM) INUSTA, *Müll. Arg.*, v. PARALLELA,

Müll. Arg.; lirellæ horizontaliter parallelæ, simplices, vulgo utrinque obtusæ.

81. Phæographis (§ Pelioloma) manipurensis, *Müll. Arg.*; thallus fusco- v. rufescenti-olivaceus, maculari-tenuissimus, lævis; lirellæ horizontaliter parallelæ, $1\frac{1}{2}$–3 mm. longæ, $\frac{1}{2}$–$\frac{3}{4}$ mm. latæ, vulgo lineari-ellipticæ, utrinque obtusæ, simplices, rectæ, emersæ, nanæ, margine thallino-tecto subnano et pluries sulcato-striato demum decolorando obscure griseo cinctæ, mox late apertæ; discus planus, obscure fuscus, nudus; perithecium pallidum, apice in sectione in lobos nigricanti-fuscos abiens, subtus hyalinum; sporæ 8næ, e hyalino mox æqualiter fuscescentes, 35–60 μ longæ, 9–10 μ latæ (halone sæpe amplo non computato), obtuse fusiformes, 12–14-loculares.—Species insigniter distincta, juxta Brasiliensem *Ph. schizoloma*, Müll. Arg., inserenda est, a qua tamen habitu multisque aliis abunde differt.

82. Graphina (§ Aulacographina) sophistica, *Müll. Arg. in Flora*, 1880, p. 40, v. parallela, *Müll. Arg.*; lirellæ simplices, parallelæ.—Thallus nonnihil fumoso-fuscidulus aut albidus, lirellæ vulgo læves, hinc inde tamen occurrunt longitrorsum leviter 1-sulcatæ, et perithecium basi valde ludit, versus extremitates lirellarum plane et valide completum, dein sensim tenuius, et parte media longitudinis optime dimidiatum.

83. G. (§ Aulacographina) semirigida, *Müll. Arg.*; thallus argillaceo-albidus, tenuissimus, lævis; lirellæ 3–7 mm. longæ, æqualiter $\frac{2}{5}$–$\frac{1}{2}$ mm. latæ, valde elongatæ vulgoque simplices et parallelæ, emersæ, ad latera strato thallino tectæ, superne solum halone thallino indutæ (impure griseo-nigrescentes), rima angusta apertæ; labia conniventia, longitrorsum subtiliter plurisulcata; perithecium basi deficiens, ad latera intus late olivaceo-fuscum, cæterum fusco-nigrum; sporæ in ascis 1–2næ, 90–120 μ longæ, 22–32 μ latæ, creberrime multilocellosæ.—Extus quasi formam lirellis gracilibus parallelis simulat *Graphinæ Acharii*, Müll. Arg., s. *Graphidi rigidæ*, Nyl., sed perithecium basi dimidiatum est, unde nomen specificum. Prope *Graphinam vernicosam*, Müll. Arg. Revis. Graphid. Féean. p. 39, et *Graphinam intricatam*, Müll. Arg. Revis. Lich. Eschw. ii. p. 13, inserenda est.—Parce lecta.

84. G. (§ Chlorogramma) fasciata, *Müll. Arg. Revis. Lich. Eschw.* ii. n. 43.

85. GRAPHINA (§ CHLOROGRAMMA) MULTISTRIATA, *Müll. Arg.*; thallus argillaceo-pallidus, tenuissimus, lævigatus; lirellæ 3–7 mm. longæ, 1 mm. latæ, simplices v. rarius et 2–3-furcatæ, rectæ et curvatæ, ad extremitates obtusæ, semicylindricæ et vertice obtusæ v. truncatæ, undique strato thallino cum thallo concolore tectæ; labia arcte conniventia, undique extus sulculis striæformibus numerosis longitrorsis ornata; perithecium undique fulvo-pallidum, ad apicem labiorum in lamellas angustas copiosas sat profunde incisum; epithecium anguste rimiforme; sporæ in ascis solitariæ (hyalinæ), 120–145 μ longæ, 30–45 μ latæ, obtuse fusiformes, intus crebre parenchymatosæ.—Ex affinitate est *Gr. chlorocarpæ* et *Gr. Balbisii*, Müll. Arg., et quidem proxime affinis et similis est Argentinensi *Gr. Lorentzii*, Müll. Arg. Observ. in Krempelh. Lich. Argent. n. 92, a qua recedit lirellis crebre multistriatis multilamellosis.

86. G. (§ PLATYGRAMMINA) OBTECTA, *Müll. Arg.*—Graphis obtecta, *Nyl. Prodr. Nov. Granat.* p. 83 (excl. v. *columbiana*), et *Lich. Kurz. Bengal.* n. 19.—Corticola ut var. seq.

— —, v. OLIGOSPORA, *Müll. Arg.*; sporæ in ascis 1–4næ (in planta normali specie solitariæ), 120–180 μ longæ, 23–24 μ latæ; epithecium nigricans (hypothecium deficiens).

87. PHÆOGRAPHINA (§ ELEUTHEROLOMA) WATTIANA, *Müll. Arg.*; thallus fusco-olivaceus, tenuissimus, lævis, margine effusus; lirellæ 2–5 mm. longæ, $\frac{1}{2}$–$\frac{3}{5}$ mm. latæ, simplices et bi- trifurcatæ, rectæ et curvatæ, ad extremitates obtusæ et acutæ emergentes, primum tectæ, siccæ cum disco demum late aperto et nudo opaco-nigræ, madefactæ aquoso-atro-sanguineæ; labia extus strato thallino tectæ, demum apice nuda et prominula, lævia; perithecium basi deficiens v. linea fusca indicatum; sporæ solitariæ, 120–140 μ longæ, 23–26 μ latæ, lineari-ellipsoideæ, crebre parenchymatosæ, e hyalino demum olivaceo-fuscidulæ.—Species insignis, juxta *Ph. scalpturatam* et *Ph. cæsio-pruinosam*, Müll. Arg., inserenda est.

88. P. (§ ELEUTHEROLOMA) CÆSIO-PRUINOSA, *Müll. Arg. Graphid. Féean.* p. 49.

89. P. (§ CHROOLOMA) CHRYSENTERA, *Müll. Arg. Lich. Bellend.* n. 46, *in Hedwigia*, 1891, p. 52.—Graphis chrysentera, *Mont. in Ann. Sc. Nat.* sér. 2, xviii. p. 39.—Sporæ sæpius diu hyalinæ remanent, demum tamen (statu sano, turgido) distincte fiunt fuscidulæ.

90. PHÆOGRAPHINA (§ CHROMODISCUS) PHLYCTIDIFORMIS, *Müll. Arg.*; thallus e glauco-albido mox purpurascens, pro genere crassiusculus, primum lævis, dein crebre rugulosus; apothecia ½–1 mm. lata, suborbicularia, sæpe varie confluentia, supra thallum emergentia, margine thallino late incrassato rugoso prædita et verrucas fere plano-hemisphæricas v. subdeplanato-tuberculiformes simulantia; discus thallino-obtectus, madefactus demum perspicuis, impure carneus aut carneo-fuscus, orbicularis aut anguloso-orbicularis aut modice oblongatus, apertus planus, circ. $\frac{4}{10}$ mm. latus; perithecium basi deficiens, lateraliter fulvescens et pallidum, rudimentarium; lamina in sectione verticali sat profunda, basi vulgo angustata, rubescenti-fuscidula; sporæ solitariæ, rufo-fuscidulæ, circ. 160–200 μ longæ, 35–50 μ latæ, obtuse fusiformes, vulgo modice sigmoideo-curvatæ, intus crebre cubico-locellosa.—Species valde insignis, prima fronte speciem *Phlyctidis* simulans, e descriptione analoga *Graphidi tuberculosæ*, Stirt. "On the Lich. of India," p. 12, et juxta *Phæographinam cheilomegas*, sc. *Graphidem cheilomegas*, Fée, inserenda est.

91. ARTHONIA POLYMORPHA, *Ach. Syn.* p. 7.—A. dilatata, *Fée*, *Ess.* p. 54, t. 13. fig. 7.

92. ARTHOTHELIUM PYCNOCARPOIDES, *Müll. Arg.*; thallus impure albus, tenuissimus, lævis et farinulentus; apothecia sicca nigra, madefacta obscure olivaceo-pallentia, vix $\frac{2}{10}$ mm. lata, suborbicularia, gregatim in maculas exiguas orbiculares et astroideo-angulosas v. sublineares dense approximata, leviter convexa, obsolete pruinosa, vix emergentia; epithecium nigro-fuscum; hypothecium fuscum; sporæ 8næ, hyalinæ, oblongo-obovoideæ, circ. 35 μ longæ et 16 μ latæ, 8–11-loculares, loculi 2–3-locellati. —Habitu simile *Mycoporo pycnocarpo*, Nyl., sed apothecia tantum confluentia, nec in peridio coadunata et hypothecium fuscum. Apothecia dein magis orbicularia quam in simili *A. abnormi*, Müll. Arg. (ubi sporæ minores), et dein a proximo *A. tædioso*, etiam forma apotheciorum et hypothecio fusco differt.

93. A. ERUMPENS, *Müll. Arg.*; thallus maculari-hypophloeodes, cum epidermide virenti-albidus; apothecia hypophloeodia, orbicularia et oblonga, hæc ⅓ mm. longa, sicca et madefacta fusco-nigra, tenuia, demum denudata, parallela, incomplete in maculas astroideo angulosas parvas congregata; maculæ diu pellicula tectæ, demum nudæ et decedentes, similis in *A. abnormi*, Müll. Arg.; epithe-

cium crassulum, cum hypothecio nigro-fusco; sporæ in ascis obovoideis 8næ, hyalinæ, 30–38 μ longæ, 14–17 μ latæ, 6–8-loculares, loculi transversim 3–5-locellati.—A proximo *A. tædioso*, Müll. Arg., differt apotheciis dimorphis diu hypophloeodicis et hypothecio nigro-fusco.—Parcissime missa.

94. Mycoporum deplanatum, *Müll. Arg.*; thallus griseo-fuscus, tenuissimus, lævigatus; peridia $\frac{3}{4}$–1 mm. lata, astroideo-angulosa, oligocarpica, madefacta et sicca nigra, planiuscula, haud distincte gibbosa; hymenia confluentia et distincta; epithecium spurium crassum, nigro-fuscum; hypothecium tenuiter nigro-fuscum; sporæ in ascis oblongo-obovoideis 8næ, hyalinæ, ovoideæ, hinc acutiusculæ, 20–22 μ longæ, 7–9 μ latæ, 8–10-loculares, demum crebre cubico-locellatæ.—Simile *Arthothelio abnormi* et *A. nucis*, Müll. Arg., sed apothecia polyhymenialia, hymenia strato crasso nigro-fusco subplano aut nonnihil undulato tecta, extus parum perspicienda et potius speciem *Arthoniæ* simulantia, demum conjunctim secedentia et cicatricem fuscam relinquentia.—Parcissime lecta.

95. M. indicum, *Müll. Arg.*; thallus cinereo-albidus, tenuissimus, minute granulari-inæqualis v. rugulosus; peridia $\frac{1}{2}$–$\frac{4}{5}$ mm. lata, suborbicularia, subregularia v. sæpius anguloso-irregularia v. astroideo-angulosa, juniora incomplete thallino-velata, dein nuda et nigra, polycarpica, superficie convexa primum gibberosa; hypothecium hyalinum; sporæ in ascis oblongatis 8næ, hyalinæ, demum fuscidulæ, circ. 33 μ longæ et 16 μ latæ, panduriformi-ellipsoideæ, utrinque late obtusæ, medio distincte angustatæ, 8-loculares, loculi transversim 3-4-locellati.—Affine *M. pycnocarpo*, Nyl., sed thallus subgranularis et peridia ambitu multo magis regularia et bene circumscripta, unde magis apparent apotheciiformia.

96. Chiodecton flavicans, *Müll. Arg.*; thallus flavicans, tenuis, confluenti-globulosus v. rugosus, superficie lævis, demum cum stromatibus cinerascenti-flavicans; stromata circ. 1 mm. lata, solitaria et confluentia, alte hemisphærica, sparsim multi-ostiolata; ostiola orbicularia, circ. $\frac{10}{100}$–$\frac{12}{100}$ mm. lata v. etiam nonnihil oblongata, plana, nigra, haud emersa; apothecia innata, leviter altiora quam lata, $\frac{13}{100}$ mm. lata, hyalina; perithecium lateraliter nullum, infra laminam semicircularem valde angustam, nigro-fuscum; sporæ 8næ, circ. 45 μ longæ, 3–4 μ latæ, bacidiales, (6-)8-loculares.—Species valde distincta, nulli arcte affinis, in

vicinitate *Chiodecton hamati*, Nyl., inserendum est.—Saxicola ad rivulos montium supra Manipur, parcissime lectum.

ENTERODICTYON, *Müll. Arg.*, gen. nov.; thallus crustaceus, amorphus; gonidia (abbreviato-)chroolepoidea; apothecia gymnocarpica, in stromatibus aggregata, chiodectina; paraphyses haud connexæ; sporæ hyalinæ, parenchymatice divisæ.—Genus *Chiodecton* ab hoc genere differt paraphysibus connexis et sporis simpliciter transversim divisis.

97. ENTERODICTYON INDICUM, *Müll. Arg.*; thallus cæsio-albidus v. demum albido-argillaceus, tenuissimus, lævis, linea nigra limitatus; gonidiorum articuli subglobosi; stromata cum thallo concoloria, lineari-ellipsoidea, simplicia aut hinc inde ramulosa, innato-emersa, circ. 1–1½ mm. longa et breviora, $\frac{1}{3}$–$\frac{2}{5}$ mm. lata, vertice deplanata, ad latera sæpe leviter undulata et tumidula, serie vulgo simplice v. rarius pro parte duplice aut irregulari apotheciorum ornata, secus lineam apicali-longitrorsam leviter depressa; apothecia orbicularia, immersa, demum $\frac{1}{5}$ mm. lata, fusca, nuda, extus haud marginata; perithecium hyalinum et tenue v. rudimentarium, basi deficiens; epithecium fuscum; hypothecium hyalinum; lamina vitreo-hyalina, paraphysibus rectis valde conglutinatis striata; sporæ in eadem lamina 1–4næ v. etiam fere undique solitariæ, hæc fere totam altitudinem laminæ æquantes, circ. 125–170 μ longæ, 50–60 μ latæ, ambitu oblongo-ellipsoideæ, intus insigniter crebre et irregulariter multilocellosæ.—Habitu accedit ad *Graphinæ* et *Phæographinæ* sectiones perithecio pallido et disco late aperto præditas.

Trib. PYRENULEÆ.

98. TRYPETHELIUM INAMŒNUM, *Müll. Arg.*; thallus fuscescenti-macularis, hypophloeodes; stromata 3–5 mm. longa, 1–2 mm. lata, parallele sita, subrhombica, leviter tantum emergentia, plana et fusca, subtecta; apothecia singula haud prominentia; ostiola e rimulis epidermidis demum perspicua, non v. vix prominula; perithecia nigra; nuclei hyalini; paraphyses tenellæ, connexæ; sporæ 8næ (hyalinæ), fusiformi-ellipsoideæ, 8-loculares, circ. 45 μ longæ et 14–15 μ latæ.—Prima fronte *Tr. infuscatum*, Müll. Arg., et *Tr. mastoideum*, Ach., simulat, sed sporæ aliter divisæ sunt et species dein in sectione *Eutrypethelio*, Müll. Arg. Pyrenoc. Cubens., inserenda est, ubi juxta *Tr. virens*, Tuck.,

locum habeat. Ab hoc ulteriore differt forma et directione et colore stromatum et peritheciis non prominulis.

99. PYRENULA ADACTA, *Fée*, *Ess.* p. 74.

100. ANTHRACOTHECIUM MANIPURENSE, *Müll. Arg.*; thallus flavescenti-pallidus, tenuissimus, lævis; apothecia atra, $1\frac{2}{3}$–$1\frac{4}{5}$ mm. lata, sessilia, nuda, hemisphærica, nonnihil conico-acutata, vertice minute umbilicato-ostiolata, opaca; perithecium basi valide completum, subtus convexum, lateraliter basi valide productum; sporæ 3(–4)næ, fuscæ, circ. 110 μ longæ et 37 μ latæ, crebre cubico-parenchymatosæ, series transversales 5–6-locellares.—Juxta Brasiliense *A. aurantium*, Müll. Arg. Revis. Lich. Eschw. n. 7, locandum est, a quo non diversum videtur nisi thallo minus aurantiaco-fulvo, apotheciis paullo altius convexis et sporis majoribus. Apothecia distincte minora et convexiora sunt quam in *A. Thwaitesii*, *A. borbonico* et *A. macrosporo*, Müll. Arg.

101. A. VARIOLOSUM, *Müll. Arg. Lich. Afric. occid.* n. 52.—Pyrenula variolosa, *Pers. in Gaudich. Uran.* p. 181.

STUDIES IN VEGETABLE BIOLOGY.—VIII. An Investigation into the True Nature of Callus.—Part II. By SPENCER LE M. MOORE, F.L.S.

[Read 18th June, 1891.]

(PLATE XXV.)

Examination of the Fig.

IN the soft bast of the Fig two methods of closing the sieves of the sieve-tubes are to be noted: the sieves lying upon the abaxial side of the bast are obliterated by means of a substance giving the ordinary dye-reactions of callus, and notably the distinctive Cambridge blue with picric Sands' sblue (Pl. XXV. fig. 1, *a*). Many of the sieves of tubes lying upon the axial side of the bast are clogged with a substance of glassy appearance and dense consistence, often possessing a yellow refringence; this does not stain with picric blue, but, like the stoppers of *Ballia*, which, when occurring in the form shown at fig. 1 *b*, it at once recalls to mind, takes a yellow colour with that reagent. It will not be

necessary to give in detail, as was my first intention, all the experiments upon the callus of the first-mentioned tubes, made primarily with the object of finding out whether it will give proteid reactions and will peptonize. The results obtained may thus be epitomized:—

1. The callus rapidly dissolves on warming sections in Millon's fluid; and does so without showing any tendency to become red.

2. It is soluble in boiling hydric nitrate; hence the xanthoproteic test does not succeed.

3. On running in caustic potash after sections have lain some time in copper sulphate, the callus swells up, but does not turn blue or pink.

4. After a good soaking in syrup, hydric sulphate swells the callus so that it is almost invisible, but it never assumes the slightest tint of pink.

5. After many experiments with a peptic fluid, allowed to act as long as 86 hours, the callus underwent not the least change in form and general appearance; and it now reacted quite normally with picric blue and corallin soda.

6. The same result followed every attempt to dissolve the callus in a pancreatic fluid (Fairchild's pancreatic extract).

On the other hand, the substance closing the sieves of the inner tubes behaves thus:—

1. It stains yellow with picric blue.

2. It takes a temporary pink with corallin soda.

3. In hydric sulphate there is no appreciable swelling up, nor in caustic potash.

4. Iodine stains it brown.

5. It is unacted on by carmine.

6. It gives good proteid reactions.

7. On many occasions it dissolved in a peptic as well as in a pancreatic fluid.

This substance therefore greatly resembles the substance of Ballia stoppers; at the same time it is quite different from callus in its reactions and chemical constitution, although the same function of obliterating the sieves is performed by both. I propose to call it "paracallus," the term callus being an unsuitable class-name to include both a proteid and a non-proteid substance.

Re-examination of the Vegetable-Marrow.

Having collected the foregoing results from the Fig, and remembering that the substance staining like callus discovered by F. W. Oliver in the trumpet-hyphæ of *Macrocystis pyrifera*, Ag., refuses to give proteid reactions and to peptonize*, re-examination of the Vegetable-Marrow seemed desirable. But very little progress had been made, when I found that I had been unfortunate in basing my conclusions with regard to Vegetable-Marrow callus upon observations which, although perfectly correct in themselves, were yet in a measure valueless, from having been made with abnormal material. I have preserved two sections derived from that material, each of them showing a considerable number of sieves all cleared after the action of a peptonizing fluid, and without the slightest suspicion of callus anywhere; and this is an obviously abnormal occurrence, in view of the undoubted fact that the true callus of the Vegetable-Marrow will not peptonize and will not give proteid reactions. In fact, it behaves in the latter respect just as does the callus of the Fig and of *Macrocystis*, either swelling up almost to invisibility, or dissolving with great promptitude. The statements made in the former memoir must therefore be understood as applying not to the true callus, but to the proteid callus, *i. e.* the paracallus; and I believe the latter substance to occur much more frequently in the Vegetable-Marrow than the former, at least that is the inference suggested from the material at my command.

Concerning this paracallus, a few more facts have been made out. In the former memoir its affinity with coagulated proteid was suggested, and this seems borne out by its behaviour with nickel sulphate and ammonia. This is Gnezda's † test for proteids; albuminates, globulins, fibrin, and mucin giving a pale-blue solution with it, while coagulated proteid is turned yellow.

Now if sections of Vegetable-Marrow bast be allowed to lie in Gnezda's fluid, the paracallus-masses will be found to be bright yellow, a colour which becomes somewhat more pronounced on running in caustic potash; and this, according to Gnezda, is a further peculiarity of coagulated proteids ‡. Another matter

* As was shown in my former memoir on callus (Journ. Linn. Soc., Bot. vol. xxvii. p. 519).

† Proc. Roy. Soc. vol. xlvii. (1890).

‡ In one case a distinct blue colour was taken by a paracallus-mass; perhaps this indicates a mixture of proteids in paracallus.

worth mention is the great difficulty met with in peptonizing the paracallus: this I suppose due to the fact that the spirit in which the material was kept was found, upon examination, to have evaporated, so that upon the dehydration undergone from the action of the spirit desiccation had supervened; and this might well tend to make the paracallus less soluble. Anyhow, be the reason what it may, I now found it impossible to entirely dissolve the paracallus in a peptic fluid; and although a pancreatic fluid was more efficient, it failed in a few cases. This should teach caution in the attempt to classify these proteids upon results yielded by preserved material: for this reason I wish it to be understood that the comparison between the substance of *Ballia* stoppers and lardacein, drawn in the former memoir, is to be regarded as merely provisional.

That an undoubted proteid should, apparently because of the dense aggregation of its particles, refuse to answer to those distinctive proteid tests—the taking up of aniline-blue and of carmine—is a singular fact; it is very often the case with the typical paracallus studied by me. Another seeming consequence of this density is the peculiar appearance borne by some sieves ("hedgehog" sieves they might be called) of desiccated Vegetable-Marrow material: the meshes of these sieves are blocked up with the hard paracallus which in surface-view projects therefrom in the form of a number of hard bristly points (Pl. XXV. fig. 7); these, like the paracallus mass itself, disappear in an effective peptonizing fluid.

The Ash.

This is a good type to study, on account of the great development of its callus: the obliterated sieves are shown, Pl. XXV. figs. 2 and 4*a*. Occasionally one may find a few sieves open during the winter; but for the most part they are blocked up with oval masses of callus presenting the normal reactions. I have not found paracallus on any of these sieves.

After many experiments, no encouragement has been given to the idea that this callus may yield proteid reactions; all the masses behave exactly as do those of the abaxial tubes of the Fig. Moreover, the callus resists both gastric and pancreatic digestion.

The Dog-Rose.

Most of the sieves of one-year shoots of *Rosa canina* are, during

the winter, blocked up with masses of paracallus. Examples of this are shown, Pl. XXV. figs. 3 *a*, *b*, *c*, and *d*. Of these, *a* represents a small mass; *b* one upon a side-wall, seen in profile; *c* a paracallus-cap, recalling a *Ballia*-stopper, hanging by paracallus-(?) threads to the sieve-plate from which it has been disturbed by sectioning; at *d* is drawn a large mass blocking two sieves from which sectioning has partly dislodged it. This paracallus gives good proteid reactions; and in some cases efforts to peptonize it met with success, though failure was sometimes experienced even after lengthy action of a gastric or pancreatic fluid.

Some General Remarks.

Experiments were also made with the Elm, with *Ampelopsis hederacea* and *Veitchi*. Of these, the former resembles the Ash; for I could find no paracallus upon its sieve-plates; while the two latter are more like the Dog-Rose inasmuch as paracallus is frequently seen in them. The callus of the rhizome of *Arundo Phragmites* is also true callus; though unfortunately, from its paucity upon the sieves of my material, I have not been able to make a thorough examination of it.

It might perhaps be objected that the paracallus is merely that somewhat denser condition of the slime met with at one or both ends of the sieve-tubes—usually at one end—and called by German writers "Schleimkopf." It undoubtedly is formed from the Schleimkopf, towards which it seems to bear the same relation that the Schleimkopf itself does to the slime. This is well seen in large cells of *Ballia*, in which we often find aggregation of the contents at one or at either end of the cell, which is capped by the paracallus-stopper. Apart from its function of obstructing the sieves, paracallus differs from Schleimkopf in its so frequent refusal to take up carmine and aniline-blue. Its chief differences from true callus have already been explained, though in this connexion one matter of interest must now be mentioned. Both callus and paracallus stain well with watery eosin; but whereas the stain taken by the former is not permanent, that imparted to the latter is so. I recently came across a beautiful instance of this. A few years ago I mounted, under one coverslip, some large sections of Vegetable-Marrow bast showing well-developed callus; these had been stained some in watery eosin, others in picric Sands's blue, and happening recently to examine the slide, I found that an interchange of stain had taken place between

callus and paracallus, the callus of eosin sections having given up its eosin and taken the blue of the other sections, while the paracallus had monopolized the eosin and had become deeply dyed with it. Of course it is usually fairly easy for the practised eye to distinguish between callus and paracallus; and if there should be any doubt on the point, it can soon be dissipated by the use of picric blue, with which callus stains a Cambridge, and paracallus (if at all) an Oxford-blue. I experienced most difficulty in dealing with the Dog-Rose, masses which in this case I thought to be callus often proving to be paracallus, and *vice versâ*.

We thus see how, *à propos* of the methods whereby the sieves are closed up, we are able to write down the following series:—

In *Ballia* we have paracallus alone.

In *Rosa canina*, *Ampelopsis hederacea* and *Veitchi*, the Fig, and *Macrocystis pyrifera* we have callus and paracallus.

In the Ash and the Elm we have callus alone.

Is True Callus Soluble in any Organic Fluid?

We can frequently get information about the nature of a substance by studying its solubilities, and this consideration led me to try the effect of diastatic ferments upon callus. The method consisted in introducing thin radial longitudinal sections into vessels containing the ferment, these being kept for some time at a temperature higher than that of the air, and generally at, or a little below, that of the human body. I have already mentioned the want of success in working with a pancreatic fluid, and as this, besides trypsin and steapsin, contained diastase as well, we are forced to conclude that callus is untouched by a diastatic ferment. This conclusion was borne out on treatment of Fig, Ash, and Elm sections with saliva for 60 hours, and for 140 hours with Kepler's malt extract, which contains a powerful diastatic ferment.

I then turned to gum-arabic with the idea that, as callus is generally supposed to be of mucilaginous nature, a solvent for it might possibly be found in the gum. In this surmise I was not mistaken; and I have several times successfully repeated my observations, which were made especially upon the Fig and the Ash. Reference to Pl. XXV. fig. 4 will bring to the eye what happens when a section of Ash-bast is placed in a solution of gum-arabic; in this case the action lasted for 49 hours at or near the tem-

perature of the body. We see how the callus has disappeared, leaving the sieve quite clear, leaving also in position the thin film of Schleimkopf which was closely apposed to the callus-mass. Fig. 5 shows what occurs in the Fig: here there was no film of Schleimkopf, and all one sees is the perfectly cleared sieve. Moreover, as showing the identity between Vegetable-Marrow callus and that of the Fig and Ash, it was found that the former substance also dissolves in gum-arabic. By this treatment one can get beautiful preparations showing cleared sieves with slime-threads passing through the pores, and so connecting the protoplasts: this is shown by fig. 6, where the sieve is seen free from callus, the Schleimkopf (*s*)—a large mass on one side, and greatly reduced on the other—remaining with the same contour that it had when callus was present, and the connecting-threads, around which the callus was deposited, remaining in their original position. These facts may be commended to anyone who favours the swelling-up theory of callus-formation, a theory which they seem emphatically to contradict.

Search for a Callolytic Ferment.

How is callus dissolved away from the sieve-plates? Most probably in one of two ways, either by means of a ferment or of an acid or alkali—possibly by cooperation of ferment with acid or alkali. I regret being unable, after spending some months upon this question, to give it a definite answer; and the case being thus, I shall not go into my various experiments in detail. If there be a callolytic ferment in gum-arabic, it must act in presence of an acid, for a solution of the gum has a decided, though not a very strong, acid reaction. Working with gum-arabic solution, I tried the precipitation method of ferment-isolation, but without any success; and the same failure followed all the experiments with glycerine extracts of crushed gum. The soft bast of the Ash gives a feebly acid reaction—at least in early spring; and this seems to indicate that the contents of the sieve-tubes are acid. With this type also both methods were tried—precipitation and glycerine-extract; but all was labour in vain. But I have not yet tried with gum-arabic the method of dialysis, which may possibly bring success in its train.

Some Remarks on the Function of Callus and Paracallus.

In the former memoir I adopted Sachs's view that the function of callus is to act as a mechanical hindrance to the flow of proteid &c. along the sieve-tubes. I do not know to what length Sachs would carry this idea, neither am I aware of any attempt to think out fully the effects which one would expect to occur were the sieve-plates not blocked up in winter with callus or paracallus, or some other substance with a similar function. Let us suppose the flow along the sieve-tubes to be absolutely without hindrance; how, then, could our arborescent vegetation survive? In these latitudes scarcely a winter passes without some days of premature warmth, during several hours of which the mercury rises far above the minimum point, and sometimes stands not very much below the optimum temperature for growth. Under these circumstances a certain amount of activity manifests itself at the vegetative points: leaf-scales elongate, and may betray a tendency towards epinasty, thus partially exposing the tender young leaves; and should the weather continue warm, the infant axes may begin to lengthen only to be destroyed with the recurrence of seasonable weather. Now if this can happen when the growing-points are shut off from access to the stores of proteid and carbohydrate pabulum accumulated in them, what would be the upshot if these stores were not safely locked up? Were this the case, we may be sure that a fortnight's warm weather in winter would witness an astonishing advance—growing axes would elongate, leaves would stretch and unroll, probably many flowers would expand; and all the energy used up over this would be so much dead loss to the plant, and worse than dead loss, because more energy would have to be drawn upon for the production of new meristematic points to replace those cut off. A healthy tree would doubtless respond to the call upon it, and during its first season, under the altered conditions, would show but faint signs of a change in the order of nature. Its store of accumulated energy would, however, be less during the following than it was the preceding winter; and this diminution would, irrespective of the loss from precocious sprouting, betray itself next year in the production of fewer and probably of smaller leaves. In fact, our supposed tree would be in the position of a person living to some extent upon his capital. We

may be certain, therefore, that but for these microscopic pieces of callus and paracallus, a few years would bring the life of our trees to an end, and the wayfarer would be saddened on seeing the monarchs of the forest stripped of all their glory and everywhere hastening to decay.

And as with temperature, so with moisture. But for callus an occasional shower or two during the dry season would stimulate a tropical tree's growing-points into activity only for the young shoots to perish upon renewal of the drought. Nor should the agency of light pass out of view: we know that callus is remarkably developed in climbing-plants, and were the flow of pabulum not carefully controlled, and so made available for the effective organs of the plant, viz. those which have reached the light, we may readily conceive how proteids and carbohydrates would tend to accumulate at imperfectly illuminated points, and how in consequence new and useless shoots would be formed there. In short, the presence of callus and paracallus prevents the expenditure of energy over the production of organs in unfavourable situations, or under conditions which, although favourable, are only temporarily so.

Summary.

1. The statement made in the previous memoir to the effect that Vegetable-Marrow callus gives proteid reactions, and will peptonize, is an error due to the misfortune of working with abnormal material. Some of the sieve-plates in the Vegetable-Marrow are obliterated by true callus which neither gives proteid reactions nor peptonizes; others at the end of the season are blocked by the proteid body studied in the former memoir. This latter substance it is proposed to call "paracallus."

2. On the abaxial side of the bast of the Fig the sieve-plates are closed-in in winter with a substance which refuses to give proteid reactions and to peptonize: upon many of the inner plates there is a hard proteid mass which frequently peptonizes. The first substance is true callus; the second (paracallus) is a further hardening of the Schleimkopf, and, when best developed, is characterized by taking up neither carmine nor picric blue.

3. In *Ballia* we find paracallus alone; *Rosa canina, Ampelopsis hederacea* and *Veitchi*, the Fig, and *Macrocystis pyrifera*

have paracallus as well as callus: while callus alone occurs in the Ash and the Elm.

4. True callus resists the action of diastatic ferments, but dissolves in a solution of gum-arabic; hence there is probably a callolytic ferment in the gum, although efforts to find it have so far been unsuccessful.

5. The function of callus and paracallus is to protect the plant by preventing the formation of new shoots under only temporarily favourable conditions of heat, light, or moisture.

EXPLANATION OF PLATE XXV.

All figures magnified 600 times.

Fig. 1. The Fig: *a*, callus of abaxial sieve-tubes; *b*, *c*, paracallus-masses upon the sieve-plates of the inner tubes.

2. The Ash: sieve-plate plugged with a mass of callus.

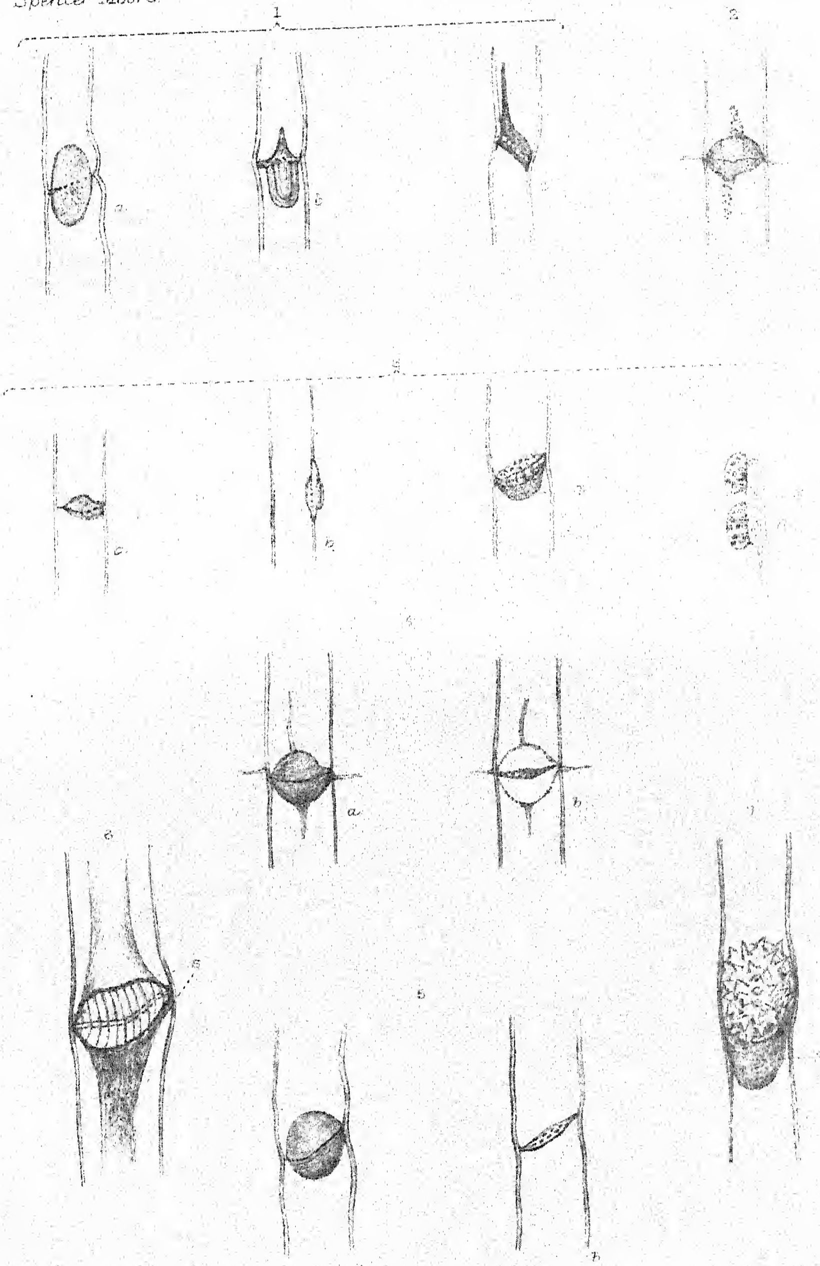
3. *Rosa canina*: *a* and *b*, small paracallus-masses upon sieve-plates; *p* in *c*, the paracallus-cap, in *d* a mass common to two sieve-plates.

4. The Ash: *a*, before, *b*, after dissolution of the callus in a solution of gum-arabic.

5 *a* & *b*. The same thing, shown in the Fig.

6. Effect of a gum-arabic solution on the callus of the Vegetable-Marrow: *s*, the Schleimkopf of contiguous sieve-tubes connected by threads of slime passing through the meshes of the cleared sieve-plate.

7. The Vegetable-Marrow: a "hedgehog" sieve: the hard paracallus projects from the meshwork in a number of points; *p*, the mass of paracallus applied to one side of the sieve-plate.



S. Moore del.
F. H. Michael lith.

West, Newman imp.

CALLUS & PARACALLUS.

STUDIES IN VEGETABLE BIOLOGY.—IX. The alleged Existence of Protein in the Walls of Vegetable Cells, and the Microscopical Detection of Glucosides therein. By SPENCER LE M. MOORE, F.L.S.

[Read 18th June, 1891.]

IN his first memoir on callus * the author alluded to the views of Wiesner and Krasser upon the constitution of the cell-wall, more especially as regards the question whether protein is or is not present therein. The bibliography of the subject having been given in that memoir, there is no necessity to present it again; as regards the new theory itself, it must suffice to say that Wiesner and Krasser and their followers, mainly on the ground that proteid reactions are frequently yielded by the walls of vegetable cells, hold such reactions to indicate the presence of protein; whereas Klebs, Fischer, and those who agree with them maintain the improbability, if not impossibility, of these reactions being due to protein, the latter writer suggesting that tyrosin may be the substance sought for. Wiesner's deduction from Krasser's microchemical studies—his dermatosome theory of cell-wall structure—has already evoked much controversy, and has had to bear the brunt of some damaging criticism, principally on the part of Klebs and Fischer. But although we may be led to differ *in toto* from the conclusions reached by the Austrian botanists, we ought not to repudiate our debt to them for starting a discussion and inviting research upon a matter which, it may be affirmed with certainty, will not be allowed to rest until some diminution has been brought about in our at present rather disreputable ignorance concerning the chemical constitution of the cell-wall.

At first sight it would seem an easy task to find out whether or no protein be a constituent of the walls of a tissue, since by the action of a peptic or pancreatic fluid we ought to be able to peptonize out the protein, after which proteid reactions should fail. The first batch of experiments, presently to be described, were made upon this assumption; but I now think the results yielded by them are not so conclusive as they formerly appeared to me; for apart from the possibility of the supposed proteid or proteids in the wall being *per se* unpeptonizable, it is

* Journ. Linn. Soc., Bot. vol. xxvii. p. 521.

quite conceivable that a peptonizable proteid might combine with some ingredient or ingredients of the wall to form an unpeptonizable compound, and this without losing its property of yielding proteid reactions. The presumption is, of course, the other way; nevertheless the possibility hinted at should not be allowed to pass out of view.

In this part of the research reliance was mainly placed upon Millon's, Raspail's, and the Xanthoproteic reactions, Copper Sulphate and Caustic Potash being a tiresome and uncertain microchemical test. These reactions will be denoted by (M), (R), and (X) respectively. The peptonizing fluids were an artificial gastric juice made with a pepsin which gave a good biuret reaction with chopped meat, and a pancreatic fluid in the form of Fairchild's powders, consisting of a pancreatic extract, five grams of which are charged with thrice the quantity of sodium bicarbonate. In these cases no very exhaustive examination of the various tissues was made, only those reacting in an obvious manner being here referred to. It was also thought better to ring the changes on a few, rather than to trust in the few reactions of a larger number of types.

Exper. I. Pancreatic fluid. Time 76 hours (R).

Ash (stem). Xylem and hard bast brown-pink; walls of soft bast not coloured.

Elm (stem). Walls of xylem and phloem brown-pink: of cortex yellow-red.

Fig (stem). Xylem and pith-walls brown-pink; bast uncoloured.

Sections of fresh tissues gave the same results precisely.

Exper. II. As before. Time 60 hours.

Rosa canina (stem). Xylem, pith, hard bast brown-pink; cortex yellower, soft bast uncoloured.

Arundo Phragmites (rhizome). Cells of sclerotized groundtissue, including the thick-walled endoderm, and xylem elements brown-pink; no colour in phloem and rest of ground-tissue.

And fresh tissues react similarly.

Exper. III. Pancreatic fluid: 60 hours (X).

Ash. Xylem faint reaction, hard bast a good one, soft bast uncoloured.

Fig. Xylem fairly good reaction, hard bast very faint ditto, soft bast and cortex not coloured.

Rosa canina. Xylem and hard bast react well, pith and cortex faintly, but cuticularized layers of the latter well.

Sections not placed in the fluid behaved in the same way.

Exper. IV. Sections of *Fig, Ash,* and *Elm* placed in pancreatic fluid for 60 hours, when tested with Copper Sulphate and Caustic Potash, gave the same reactions as did fresh sections.

Exper. V. Peptic fluid: 60 hours (X).

Fig. Same reaction as with sections treated with pancreatic fluid, except that the faint colour in the hard bast of the latter was not apparent.

Ash. As with sections treated with pancreatic fluid.

Arundo Phragmites. Ditto.

Veg.-Marrow (stem). Xylem good reaction, none elsewhere, xcept very faintly in bast, and fresh sections behave similarly.

Exper. VI. Peptic fluid: 60 hours (R).

Ash. Reaction the same as after the pancreatic fluid.

Fig. Ditto.

Rosa canina. Ditto.

Arundo Phragmites. Ditto.

Veg.-Marrow. The walls giving the Xanthoproteic reaction gave Raspail's. So did those which had not been in the fluid.

Exper. VII. Peptic fluid: 61 hours (M).

Fig. Faint reaction in xylem alone: unpeptonized sections ditto.

Arundo Phragmites. Parts giving (X) and (R) gave this in precisely the same way as did fresh sections.

Veg.-Marrow. As with (X) and (R), and to the same effect as fresh sections.

It seemed unnecessary to further repeat these observations, as in twenty-three cases, after the action of proteolyzing fluids during from 60 to 76 hours *, the proteid tests were got with the same ease and distinctness after as before treatment. One must hence conclude that if protein really exist in these walls it must be present in some unpeptonizable form.

* In some other experiments, which may be passed over without further reference, the action (pancreatic) was continued for 146 hours, after which normal reactions were still obtained (*Maize, Rosa canina, Isoëtes lacustris*).

A Search for some other Substances reacting like Proteids.

Of non-proteids, the only body hitherto discovered which will give all ordinary proteid reactions is, according to Krasser *, tyrosin. Hence, by the process of exclusion, we may dismiss other substances yielding one or more but not all of these reactions, for it is quite unnecessary to suppose that one reaction is due to one substance, and another to a second, and so on. However, in order to leave no stone unturned, resort was had to the method already applied by the author to *Ballia* stoppers. This is, to select a given reaction, and place the tissues to be experimented with in fluids which act as solvents of the substances yielding that reaction. Thus, of the bodies giving Millon's reaction, supposing them to exist as such in the cell-wall and not to form insoluble compounds therein, we know that:

I. Alcohol and Ether should dissolve out Nitrobenzole, Phenol, Thymol, and Naphthol.
II. Acid and Alkaline solutions should dissolve out Tyrosin.
III. Water should dissolve out Vanillin.

And this treatment leaves only the aromatic oxy-acids unaccounted for, since preliminary examination showed, from the absence of reddening on addition of Hydrochloric Acid, that Phloroglucin could not be the substance sought for.

The results of these experiments are here appended.

I. Sections kept in absolute alcohol for three weeks.
Fig (M). Xylem faint reaction—none elsewhere.
(X). Fairly good reaction in xylem—hard bast not seen.
(R). Good reaction in the way already indicated.
Arundo Phragmites (M). Normal reaction.
(X). Ditto.
(R). Ditto.
Rosa canina (M). Failed.
(X). Good reaction in tissues already indicated.
(R). Ditto.
Ash (M). Failed.
(X). Faint reaction in xylem: good in hard bast.
(R). Normal reaction.

* See Krasser's list on p. 523 of the Author's first memoir on callus, in Journ. Linn. Soc., Bot. xxvii.

Experiments were also made with stems of Maize and Vegetable-Marrow, but derived from spirit-kept material. The result showed that even after three weeks' action of absolute alcohol, in addition to a long sojourn in spirit, the proteid reactions were yielded in the normal fashion. Thus, out of seventeen cases (two reactions only were tried with the Vegetable-Marrow from lack of material) we find failure occurring twice only, and any-one who has tried these tests, using thin sections, knows that he must expect occasionally to fail with them.

II. Sections kept three weeks in Hydrochloric Acid (50 per cent. solution of the strong acid).

Ash (M). Normal reaction.
(X). Ditto.
(R). Ditto.

Fig (M). Normal reaction.
(X). Ditto, with a faint reaction in hard bast.
(R). Normal.

Rosa canina (M). Reaction normal.
(X). Good reaction xylem: extraxylemic tissues not noted (apparently they must have got separated from the xylem and so escaped observation).
(R). Normal.

Arundo Phragmites (M). Good reaction as usual.
(X). Ditto.
(R). Failed, except at one corner of the section.

Maize (M), (X), and (R). Quite normal.

Isoëtes lacustris (stem) (M). Good reaction in xylem of great central vascular bundle, as also of leaf-trace bundles: in one case meristem-walls reacted well, but the test failed with another section. Fresh sections (derived from spirit-material) give good reaction in xylem and (generally) in meristem.

We may hence conclude either that tyrosin is absent, or that it has entered into some insoluble compound with a substance or substances in the wall.

III. Sections kept in Water for three weeks.

Fig (M), (X), (R). As in fresh sections.

Arundo Phragmites. Ditto. Ditto.

Maize (M), (X), (R). Reaction as with fresh tissues.

Rosa canina (M), (X), (R). Quite normal.

Ash (M), (X), (R). Normal in every way.

Krasser's List of Bodies reacting like Proteids not an exhaustive one.

Upon the general question we now stand in this position. The substance giving these proteid reactions cannot be protein unless

(*a*) it be some unpeptonizable proteid, or

(*b*) it be a proteid which has entered into some unpeptonizable combination with cell-wall substance.

That (*b*) should express the truth seems highly improbable. With regard to (*a*), although not impossible, one may remark upon its *à priori* unlikelihood, and the question may be asked, What is proteid doing in the wall? Surely, to use up so complex a body over such a task as forming the actual substance of the wall must argue what seems to us great improvidence on the part of the plant, supposing other means to be available. Moreover, it is highly significant, from an objector's point of view, that proteid reactions are given best by the walls of lignified elements—elements useful for support and for conduction of fluid, but at the same time elements in which metabolism either soon ceases or but feebly persists. So far, however, Wiesner's theory seems to be preferable to Fischer's, because, while unpeptonizable proteids are known to exist, we do not know of insoluble compounds with tyrosin. A solution of the problem might possibly be found could we discover some substance which, while giving proteid reactions, will free us from the necessity of supposing that we are dealing with a body which, when it reaches the cell-wall, suddenly becomes transformed from what it was, so that if a proteid it is now unpeptonizable, if tyrosin it becomes insoluble in acids and alkalies. Moreover, *if our supposed substance belongs to a class of bodies known already to exist in the cell-wall; if its presence there can be microchemically proved by a series of tests other than those employed in the detection of proteids; still further, if the same series of*

reactions, proteid and non-proteid, be yielded by some non-proteid substance stored up in special cells of the same plant, and yielded in so definite a manner that precisely the same shade of colour, peculiar to a certain type, is imparted by a reagent, proteid or non-proteid, alike to cell-wall and to the substance stored up in the special cells—if such a substance there be, then it is submitted that the theories of Wiesner and of Fischer must stand aside until its full examination has been carried out, and stand aside with the odds against their reappearance as being, on the supposition that the above-made statement can be substantiated, quite unnecessary attempts to explain the phenomena in question.

My attention was directed to glucosides, which we already know to exist in the cell-wall. The method was first to try whether one of these will give proteid reactions, and the following were the results of this trial with the tannins.

Here and elsewhere (M), (X), (R), and (C) represent Millon's, the Xanthoproteic, Raspail's, and the Copper Sulphate and Caustic Potash reactions respectively.

Effect of Proteid Reactions on Tannic Acid.—(M). A yellow-ochre precipitate, becoming on boiling a warm brown with very slight suggestion of madder.

(X). Addition of hydric nitrate turns a solution of tannic acid yellow: this deepens on boiling, and with ammonia becomes a dark orange-brown, and quite black if the solution be strong.

(R). When hydric sulphate is poured into a syrupy solution of tannic acid it falls to the bottom of the test-tube, at the same time producing a white precipitate in the solution: after some hours the acid turns black and the precipitate pale pinkish.

(C). A solution of Copper Sulphate gives a lavender precipitate, which Caustic Potash turns grey, and greenish on boiling.

This is not very promising. We see that (M) fails, as does (C). (X) succeeds, and so does (R) to a certain extent.

Effect of Proteid Reactions on a Solution of Catechu.—When, however, a solution of Catechu is tried, the result is very different: thus:—

(M). Gives a yellow precipitate, *becoming dark brick-red on boiling.*

(X). Hydric Nitrate gives *a yellow colour to the solution, which deepens to orange when ammonia is added after boiling.*

(R). The Hydric Sulphate falls to the bottom of the test-tube,

and a light red precipitate forms at junction of acid and solution: *soon on the rest of the overlying liquid a pink colour appears,* which after some hours becomes brown-pink.

(C). With Copper Sulphate a grey precipitate, becoming brown on boiling with Caustic Potash.

Hence with Catechu, (M), (X), and (R) succeed: (C) fails, *and this latter may therefore be employed as a crucial test: as the sequel will show, it also fails with cell-walls.*

To Krasser's list, therefore, we must add, as giving (X), tannic acid: as giving (M), (X), and (R), a solution of Catechu.

One may also mention here Gnezda's * test for proteids—a solution of Nickel Sulphate charged with Ammonia. To various proteids studied by Gnezda it gives a blue or a yellow colour, the blue becoming yellow, the yellow orange on addition of caustic potash. Tannic acid gives with this a flocculent dirty pink precipitate, not changing with caustic potash: catechu a slight brown precipitate, which on pouring in caustic potash becomes flocculent and somewhat paler in colour.

Hence this test also fails with the tannins, and so should furnish evidence of a crucial character.

Cell-walls giving Proteid Reactions will give Tannin Reactions as well.

If now our cell-walls, supposed, by yielding proteid reactions, to contain proteid, will give tannin reactions as well, we have a strong confirmation of the idea that tannin and not proteid is the substance we are in quest of. But before going further into this matter, it is necessary to remind the reader that the colours one recognizes in thin sections under the microscope through strong transmitted light must vary somewhat from those seen in making test-tube experiments. Thus, browns will tone off to yellows as the section becomes thinner; reds to pale pink and greens towards yellow, while grey will tend to become invisible, and so on.

It must be premised that, as the reader is doubtless aware, tannic acid gives with iron salts a blue-black and catechu a green precipitate. With both, Nessler's fluid (test for Ammonia) gives a brown precipitate, and potassium bichromate does the same with a solution of tannic acid, catechu striking a warmer

* Proc. Roy. Soc. vol. xlvii. (1890).

brown with the bichromate. As already mentioned, copper sulphate throws down a lavender precipitate with tannic acid, with catechu a grey.

The various reagents will be treated of seriatim.

Action of Potassium Bichromate.—(*a*) Stem of *Rosa canina.* Xylem, hard bast and cuticle are turned pale brown: fundamental tissue (including the collenchyma), soft bast, and cambium a rich brown.

(*b*) Stem of *Isoëtes lacustris.* Meristem walls turned brown: the xylem walls of the vascular bundles are naturally brown in the spirit-preserved material used, hence it is difficult to say whether the bichromate has any effect, but apparently it has.

(*c*) Stem of the Fig. Xylem brown (yellow if the section be thin): hard bast and collenchyma yellower; rest of fundamental tissue, soft bast, and cambium still paler yellow.

(*d*) Stem of *Arundo Phragmites.* Walls giving proteid reactions are coloured a light brown.

(*e*) Stem of the Maize. The same as *Arundo Phragmites.*

Action of Ferric Chloride.—(*a*) *Rosa canina.* A blue colour is *immediately* seen in the collenchyma walls, and may be traced, but very faintly, in the soft bast and cambium. This soon passes away, and now the above tissues resemble the xylem and hard bast, all taking a pale but distinct greenish colour.

(*b*) *Isoëtes lacustris.* Meristem walls pale greenish; ditto the xylem walls apparently, though the naturally brown colour interferes with the reaction.

(*c*) The Fig. All tissues greenish: colour best seen in xylem, hard bast, and collenchyma; latex green.

(*d*) *Arundo Phragmites.* Exceedingly faint greenish reaction in walls giving proteid reactions.

(*e*) The Maize. Lignified walls turned a light green.

Action of Nessler's Fluid.—(*a*) *Rosa canina.* Fundamental tissue, soft bast, and cambium brown: xylem and hard bast pale yellow, with faint suggestion of greenish, and signs of faint browning in some of the walls.

(*b*) *Isoëtes lacustris.* Meristem cells pale yellow.

(*c*) The Fig. Xylem, collenchyma and rest of fundamental tissue, soft and hard bast pale greenish-yellow: latex yellow. After a time a very faint pinkish hue can be detected in the hard bast, and the latex becomes browner.

(*d*) *Arundo Phragmites.* Walls giving proteid reactions are turned yellowish green.

(*e*) The Maize. Walls giving proteid reactions take a yellowish-green colour.

Action of Copper Sulphate.—(*a*) *Rosa canina.* Collenchyma, and to a slighter extent rest of cortex, soft bast and cambium turned a lavender colour: xylem and hard bast a faint yellow.

(*b*) *Isoëtes lacustris.* Meristem walls no appreciable effect.

(*c*) The Fig. Walls of hard bast take a lavender hue; this is seen but faintly in the other extraxylemic tissues, best in the collenchyma. Xylem as xylem of Rose.

(*d*) *Arundo Phragmites.* Walls giving proteid reactions turn faint greenish yellow.

(*e*) The Maize. Ditto.

To these results may now be added some macroscopic ones yielded by tissues which give more or less clear proteid reactions. Take three pieces of bottle cork, moisten thoroughly a face of one piece with ferric chloride, of the second with Nessler's fluid, and of the other with potassium bichromate: after a little time the first will be green, the second brown, the third yellow-brown. These observations upon cuticularized tissues are given here, but no attempt has been made in this research to study such tissues fully. The greening of cork with ferric chloride must be familiar to anyone who has taken "steel-drops" kept in a corked bottle.

Dip the end of a match into ferric chloride—it will dry green: another match-end dipped in Nessler's fluid will dry yellow, a third dipped in potassium bichromate brown.

[It may be mentioned that a match-end gives a good (M) reaction and a fair (X) one. With pieces of cork (X) succeeds admirably, if the precaution be taken of thoroughly softening them with hydrochloric acid before boiling; (M) also gives a reaction, but not a good one, apparently from the difficulty of wetting the cork thoroughly.]

Some Reactions given by Tannin in the Plant.

We will now go a step further and inquire how tannin behaves in the idioblasts and ordinary cells of certain plants. In this part of the research it is well to remember how clear an answer to questions about tannin is frequently given by tissues *at or near the surface.* There are several reasons, I take it, why tannin should be found here, for—

(1) Stored at or near the surface it is withdrawn from the drama of metabolism going forward in other parts, interference with which drama might be expected were it present in too great quantity.

(2) It performs the police function of warding off enemies on account of its bitterness.

(3) The forms of tannin yielding a yellow diffusible substance with alkalis travel to the surface to be excreted from the plant by the agency of the ammonia of dew, rain-water, and the soil.

We will take first the leaf of the Primrose, and, by simply tearing off pieces of its epiderm, study the reactions of the tannin stored up in the idioblasts of that tissue.

Proteid Reactions of Tannin of Primrose Epiderm.—A fairly good (M) reaction: the colour is a brown-pink, so deep in many of the idioblasts as to appear quite black: the pink colour I could not get in many of the trichomal cells—the colour here was usually brown, ultimately becoming yellow. A very good (X) reaction. With regard to (R), in a syrupy solution hydric sulphate throws down a grey precipitate in the idioblasts; this soon becomes a beautiful warm brown, and finally almost pink.

Failure of other Proteid Reactions with Primrose Tannin.—(C) fails; copper sulphate gives a grey-brown colour, which turns to orange when caustic potash is run in.

Gnezda's test (nickel sulphate and ammonia) also fails: instead of a blue or a yellow, becoming yellow or orange respectively on addition of caustic potash, Primrose tannin takes a pinkish-grey, not appreciably changing with caustic potash.

Proteid Reaction of the Tannin of the Ivy.—(M) reaction not very good: indeed it is seen properly only when tannin is aggregated at the base or the apex of a trichomal cell—here, however, it is a fair reaction. Possibly the cuticularization of the walls of the hairs causes interference with the result, since tannin in the fundamental tissue of the stem and petiole reacts well.

(X) succeeds admirably, but the precaution must be taken of only warming the nitric acid, otherwise all the tannin will diffuse out of the cells.

(R) frequently succeeds perfectly, but the effect must be carefully watched for, as it soon passes off.

Copper sulphate gives a pale grey or greenish grey, becoming light brown or greenish brown on boiling.

With Gnezda's fluid a yellow diffusible substance makes its appearance: in fact the ammonia appears to act alone, just as does the caustic potash of Nessler's fluid. Coagulated proteids turn yellow with Gnezda's fluid, but it goes without saying that this diffusible substance cannot be coagulated proteid.

Proteid Reactions of the Tannin of Rosa canina.—The fundamental tissue of the young stem was chiefly consulted, the epiderm not being detachable; the latter tissue was also experimented with to some extent.

(M). A dark colour—seemingly quite black—in cells with much tannin: this is pink-brown in presence of tannin in smaller quantity.

(X). A good reaction, but the acid should not be boiled, only warmed.

(R). A beautiful brown-pink, like the colour taken by primrose tannin.

Copper sulphate gives a blue colour, and on boiling with caustic potash a grey precipitate is thrown down.

Gnezda's fluid throws down a pink-brown precipitate, becoming a little browner on addition of caustic potash.

Proteid Reactions of the Cell-walls.

It will here be advisable to present, in some cases in more detail than before, a statement as to the proteid reactions yielded by the cell-walls of the types studied.

(*a*) (M). *Rosa canina.* Besides the good reaction in the xylem and hard bast, there is a reddish yellow in the collenchyma, and to a less degree in the rest of the extra-xylemic tissues.

Isoëtes lacustris, Fig, *Arundo Phragmites*, and Maize. As already mentioned, with reference to the Fig, it is important to remember that the reaction is given by the xylem, but not by the hard bast or other tissues lying outside the xylem.

(*b*) (X). *Rosa canina.* Good reaction in xylem, hard bast, and cuticle: faint reaction elsewhere.

Isoëtes. Good reaction in xylem of vascular bundles of stem: pale reaction in the meristem.

Fig. Besides the reaction of the xylem, a faint one is given by the hard bast, and in the soft bast and cambium scarcely any colour can be detected.

Arundo and Maize as already mentioned.

(*c*) (R). Rose: xylem and phloem a faint reaction, the colour being far more brown than pink: the other extra-xylemic tissues turn orange or yellow, in which a faint pink can often be detected.

Isoëtes. Reaction failed with the meristem.

Fig. Xylem not at all a good reaction, the colour being very brown. The same colour is taken by the latex and by the tannin in the cells of the medullary rays. Bast fibres and collenchyma no reaction.

Arundo. Endoderm and xylem brown-pink: the other walls uncoloured.

Maize. As *Arundo*.

(*d*) (C). Copper sulphate gives a pale grey to xylem and hard bast of Rose: a pale lavender (best seen in thickish sections) in extra-xylemic tissues. On running in caustic potash and boiling, xylem and hard bast become brown (yellow if section be thin); the other tissues become brown, with a suggestion of greenish.

Isoëtes. Effect of copper sulphate alone is inappreciable. On boiling with caustic potash the meristem walls are turned brown, but the other walls also behave similarly.

Fig. Before boiling there is a green colour in the xylem, and a very pale grey in the walls of the other tissues: this grey is often not appreciable—it is best seen in the hard bast, in which there is a suggestion of blue. On boiling, the respective colours become more marked.

From this it might be concluded that the hard bast of the Fig yields a (C) reaction: it must be remembered, however, that no other proteid reaction—except (X) very faintly—is given by this tissue, while the xylem, which gives proteid reactions, does not do so with copper sulphate and caustic potash.

Arundo. Walls giving other proteid reactions are turned yellowish grey with copper sulphate: this becomes brown on boiling with caustic potash.

Maize. Much as *Arundo*.

(*e*) Gnezda's test. Rose: xylem and hard bast a pale brown-yellow, seen well only when the section is somewhat thick: collenchyma, soft bast, and cambium a dirty pink. No change of colour on adding caustic potash.

Isoëtes. Meristem walls a pale brown.

Fig. Xylem yellow: other tissues pale yellow, best seen in

collenchyma and hard bast: latex dirty yellow: no change with potash.

Arundo. Walls giving proteid reactions turn pale yellow, the colour becoming slightly more pronounced on addition of caustic potash. Potash and ammonia, however, will give the same colour when used alone.

Maize. Very similar to *Arundo.*

Behaviour of Tannin-solutions to some other Reagents.

(*a*). Behaviour to Iodine (solution of normal strength):
with tannic acid a pale sherry colour;
with catechu a brown sherry colour.

(*b*). To Schulze's solution:
tannic acid—a copious dirty pink precipitate;
catechu—a copious rich brown precipitate.

(*c*). To a watery solution of Methyl green:
tannic acid—a blue-green;
catechu—the green taken by the nucleus.

(*d*). To Picric Sands's blue:
tannic acid—the normal grass-green of this dye;
catechu—a yellow green.

(*e*). To Corallin-Soda: tannic acid—a pale pink;
catechu—a deep brilliant pink.

Behaviour of Tannin in the Plant to other Reagents.

(*a*). Iodine: Rose—a rich brown colour.
Primrose—ditto.
Ivy hairs—yellow, but brown when the hair is seen edgewise, a greater depth of tannin thus coming into view.

(*b*). Schulze's solution: Rose—pinky brown.
Primrose—brown-pink.
Ivy—yellow.

(*c*). Methyl green: Rose—green.
Primrose—green.
Ivy—also green.

(*d*). Picric Sands's blue: Rose—blue.
Primrose—blue.
Ivy—yellow.

(*e*). Corallin-Soda: Rose—pinky brown.
Primrose—ditto.
Ivy—brilliant pink.

(*f*). Borax Carmine: no colour taken up in any case, except that sometimes in the Primrose idioblasts a very faint blue can be seen.

On comparing this series of reactions with that which immediately precedes, the reader will notice a close agreement in the behaviour of tannic acid and of Rose and Primrose tannin, while no less suggestive a resemblance holds between a solution of catechu and Ivy tannin. *Now the tannin of the Rose and Primrose is iron-blueing tannin: that of the Ivy is iron-greening, like catechu.*

Behaviour of the Cell-walls to these various Reagents.

Many of the reactions mentioned under this head are perfectly familiar ones. However, it is necessary to refer to them in marshalling the evidence upon which are based the views here maintained.

(*a*). Iodine. Rose: xylem, hard bast, and cuticle distinctly yellower than the other extra-xylemic tissues.

Isoëtes. Meristem walls brown; other walls yellow.

Fig. Xylem brown-yellow; hard bast pinkish red: other extra-xylemic tissues pale yellow, but very faint suggestion of pinkish in the collenchyma, though this last reaction may fail. Latex yellow and red.

Arundo. Walls giving proteid reactions red-brown; other walls much paler.

Maize. As *Arundo.*

(*b*). Schulze's solution. Rose: cuticle, xylem, and hard bast yellow; collenchyma and other extra-xylemic tissues lightish brown-pink.

Isoëtes. Meristem walls yellow.

Fig. Xylem yellow: hard bast a brilliant rose-colour; rest of extra-xylemic tissues a very pale pinkish, like the rose-colour much diluted.

Arundo. Walls giving proteid reactions yellow-brown; other walls much paler.

Maize. As in *Arundo*, except that colour taken is a redder brown; in bast walls and unlignified part of xylem a purple appears.

colr). Methyl-green. Rose: xylem and hard bast green like nuclei; other tissues bluer.

Isoëtes. Meristem walls green, in beautiful contrast with the blue walls not giving proteid reactions.

Fig. Xylem green, elsewhere blue, seen best in hard bast; latex blue or green.

Arundo. Walls giving proteid reactions green; rest blue.

Maize. Ditto.

(*d*). Corallin-Soda. Rose: xylem and hard bast deep pink; other walls brown-pink.

Isoëtes. Meristem walls pink.

Fig. Xylem pink; other walls unstained, or but very faintly.

Arundo. Walls giving proteid reactions deep pink; other walls browner pink.

Maize. As *Arundo*, but the "other walls" are pink-brown or uncoloured.

(*e*). Picric Sands's blue. Rose: cuticle, hard bast, xylem yellow; other walls blue.

Isoëtes. Meristem walls yellow, best seen if sections be not too thin.

Fig. Xylem yellow, hard bast a beautiful sky-blue; other walls very pale blue, best seen in the collenchyma; latex yellow, blue, or green.

Arundo. Walls giving proteid reactions yellow; others blue.

Maize. Ditto.

(*f*). Borax Carmine. Rose: colour not taken up at all except by the collenchyma walls, which stain a *very faint* pinky-bluish colour which soon washes out.

Isoëtes. No colour taken up.

Fig. Ditto, and no colour taken up in many of the latex-canals, though frequently the latex is brilliantly stained.

Arundo. As *Isoëtes.*

Maize. Ditto.

Some Identities between Reactions of Cell-walls and of Tannin Idioblasts, and some general considerations.

The main object of this memoir being to prove that it is the tannin in cell-walls which gives them the property of reacting like proteids, the reader's attention is requested to the already-mentioned identity between the reactions of tannin in a plant

and those of its cell-walls. Thus we see that the lignified walls of the Rose, *Arundo*, and Maize, and the xylem of the Fig give the three proteid reactions, and stain yellow or brown with iodine, green with methyl-green, bright pink with corallin-soda, and with picric-blue yellow, while they refuse to take up borax carmine. These reactions are also given by a solution of catechu and by the iron-greening tannin of the Ivy—some being given too by the iron-blueing tannin of the Rose and the Primrose. Further, we can get iron-greening tannin-reactions in these walls, whose behaviour, moreover, to the (C) and Gnezda's tests closely resembles that of the tannins, and is quite unlike that of proteids. There are, however, in the walls of *Rosa canina* indications of the presence of two kinds of tannin, the iron-blueing kind showing itself in the fundamental tissue, soft bast, and cambium. Now, the presence in the tissues of the Rose of an iron-greening as well as an iron-blueing tannin was mentioned in the memoir on tannin *, and several experiments proved conclusively that many of the reactions already given as characteristic of iron-greening and of iron-blueing tannin can be obtained when the tissues of the Dog-Rose (fundamental tissue of young stem, epiderm, and hairs) are examined.

The xylem and hard bast of the Rose agree thoroughly in their reactions, all of which can be explained on the supposition that there is an iron-greening tannin, or a derivative of such, still behaving in the same way to dyes, &c., in the walls of these tissues. With regard to the other tissues, especially the collenchyma, the evidence is not so plain. An iron-blueing tannin is clearly present here, and by mixing solutions of tannic acid and of catechu in a certain proportion, and precipitating with Schulze's solution, one can closely match the colour taken by the collenchyma with that reagent. This and some other reactions would seem to imply the presence of two tannins, an iron-greening and an iron-blueing, in these walls; nor should this excite surprise, seeing that Dufour has found both kinds of tannin in the epiderm of *Sedum Telephium*, while the same thing occurs in the Rose, and, as will hereafter appear, in the Fig as well. But it must be remembered that in these matters we are working quite in the dark; as, irrespective of other substances which undoubtedly are present in the cell-walls, we

* Journ. Linn. Soc., Bot. vol. xxvii. p. 530.

have to deal with "pure cellulose," if indeed there be such a substance.

Let us now take the Fig. The chief point to notice here is the complete difference between its xylem and its hard bast in respect of their reactions, for whereas the xylem closely resembles that of the Rose, and may be supposed to contain an iron-greening tannin in its walls, the hard bast of the Rose is quite different from that of the Fig. Assuming the foregoing reactions in the latter tissue to be due to one substance, this is an iron-greening body, giving other tannin reactions, behaving negatively to proteid tests, except (X) faintly, taking a lavender colour (as does tannic acid) with copper sulphate, a pinkish red with iodine, with Schulze's solution a rose colour, a blue with methyl-green, and a sky-blue with picric-blue, and behaving like the tannins in its refusal to take up carmine. All this is evidence as to the existence in these walls of a tannin or tannin-like body; and the fact that the same reactions are yielded by the latex as by (*a*) the xylem, and by (*b*) the hard bast, is of some value as a confirmation of this view, since latex is well known as being rich in tannin. Moreover, when we come to study tannin in the tissues of the Fig, we get all the various reactions characteristic of the xylem and of the hard bast respectively: the latter are yielded chiefly by the short clavate hairs with which the young parts (stems, leaves, cœnanthia) are abundantly clothed, but also by certain epidermal cells as well. On the other hand, the tannin of the xylem can be found in the epiderm and in the long hairs clothing young parts. The extra-xylemic tissues other than the hard bast appear to have in their walls the same substance as is found in the hard bast, but in very slight, often only just appreciable, quantity.

The other cases are simpler; in the meristem walls of *Isoëtes lacustris*, and in the lignified elements of *Arundo Phragmites* and the Maize, there is evidence of an iron-greening tannin reacting like catechu. The purple reaction of the bast and unlignified xylem-walls of the Maize may perhaps indicate the existence of cellulose in a pure state; but although the reaction is always supposed to point to cellulose, the matter is one worth further examination. In these cases no opportunity has offered of studying tannin in the tissues.

Further Evidence as to the Presence of Tannin in Cell-walls.

One rather interesting confirmatory test has come off in the case of lignified walls; this is the coniferin test (hydrochloric and carbolic acids), coniferin being known by the green colour taken in sunlight by lignified walls treated with these reagents. If sections so treated be left overnight in the mixture of acids, the lignified walls will be stained red in the morning. Now a solution of catechu gives with these acids a splendid brick-red precipitate.

A priori, it should be easy to ascertain whether tannin is the cause of the proteid reactions of cell-walls, for we ought to be able, by simply boiling sections in dilute acids, to break up the tannin with formation of glucose, and the reactions should now fail. I have succeeded in this to a certain extent with the hard bast of the Fig, thus proving the peculiar substance in its walls to be a glucoside. The bast-fibres of a section boiled for a minute or so in the acid do not turn red on subsequent treatment with iodine after careful washing, nor do they take a rose colour with Schulze's solution, nor a blue with methyl-green under similar circumstances. With regard to the special tannin-reactions the result is less satisfactory, since the effects are marred by the appearance of a grey colour in the hard bast walls during the boiling with the acid. Again, in the meristem walls of *Isoëtes* it is obviously a glucoside which gives the proteid reactions, for these fail in the case of sections boiled for a few minutes with dilute hydrochloric acid. But when we come to study ordinary lignified walls we are met by the difficulty of a fine red colour appearing in these walls after a short boiling in dilute acid. I am at present unable to say to what this colouring is due; perhaps to coniferin or catechin, neither of which I have yet been able to procure: pyrocatechin it certainly is not, for no red colour is got on boiling a solution of this body with hydrochloric acid *. On the other hand, I find that on boiling a solution of catechu in dilute hydrochloric acid a fine red colour is very apt to appear in the liquid, although this colour vanishes on shaking the test-tube. I think we have reason to suspect from this that the red colour taken by lignified walls boiled in dilute hydrochloric acid may be a decomposition product of a tannin, but the point requires further examination.

* It may be noted that pyrocatechin gives not one of the five proteid reactions employed in these researches.

I also boiled sections of the rhizome of *Arundo Phragmites* in pure hydrochloric acid for a couple of minutes. By this treatment the lignified walls were turned straw-yellow, and on trying Millon's reaction, after thoroughly washing away all traces of acid, a much browner colour than usual was taken by the lignified walls. Something similar is seen when hydrochloric acid is added to a solution of catechu; the solution takes a yellow colour, becoming deeper on boiling, and on pouring in Millon's fluid a dirty white precipitate is thrown down, and this does not change colour on boiling.

Two reactions of lignified cell-walls have a significant bearing upon Wiesner's theory: these are their refusal to take up aniline-blue and carmine, two distinctively proteid tests, and when we remember that tannin will not stain with either of these dyes, we have in this a strong confirmation of the theory here advocated. It may indeed be retorted upon me that in the memoirs on callus I have myself described a substance (paracallus) which, although an undoubted proteid, yet will take up neither aniline-blue nor carmine. But it must not be forgotten that, whereas paracallus is a very dense substance, and apparently derives its inability to stain from this fact, lignified cell-walls are specially adapted to take up fluids, and so should stain well were protein present in them—indeed, they stain admirably with dyes which are also taken up by iron-greening tannin. But these are only two of a large series of reactions which cannot all be merely accidental, and this has firmly convinced me that the substance in these cell-walls is not protein.

A solution of catechu contains mimo-tannic acid and catechin: both these substances are said to give a green precipitate with iron salts, and I much regret not having been able to get them in the pure state. If the reactions of catechin are like those of pyrocatechin, the substance in cell-walls would seem to be mimo-tannic acid, for a solution of pyrocatechin reacts quite differently from the substance in cell-walls. This matter, however, requires further study.

I have asked, what is protein doing in the cell-wall? The rejoinder to this might be, what is the glucoside doing there? In answer to this, reference might be made to the suggestion thrown out in my memoir on tannin that the glucoside, an otherwise useless body, is made use of in lignification. But in view of

Haberlandt's recent discovery of tannic acid, or at least a body very like it, as the osmotically active substance in the sensitive plant, I think one may venture a little further and suggest that it may be to the glucoside that the peculiarities of lignified walls are due, the tannin performing the same osmotic function in these walls that it does in the cells of the *Mimosa*. But when occurring in meristem-walls tannin is apparently passing through on its way to idioblasts, or to be excreted, &c., and the tannin of the soft bast, collenchyma, &c. is probably transmigratory also.

It will be remembered that lignified walls stain green with methyl-green just as does the nucleus. Can this imply the presence in relatively large quantity of an iron-greening tannin in the nucleus? Such an idea would harmonize with present views of the nucleus as governing the formation of proteid in cells. I throw this out as the merest suggestion, for the similarity in reaction between the nucleus and the walls may well be casual merely, and I do not wish to lay myself open to the charge of riding a hobby to death.

Yet one more suggestion. In studying the Fig the reactions of the latex were carefully attended to, with a result which plainly indicated the presence in it of the substance giving, as I suppose, the proteid reactions in cell-walls, and of the other body (glucoside) found in greatest quantity in the hard bast, but also in the other extra-xylemic tissues. Is it therefore possible that the proteid reactions of the latex may be due to tannin, and not to protein at all? The only reaction which tells against this is the taking up of carmine; but we have seen this to happen by no means universally. The matter requires further investigation, and the behaviour of the latex of other types seems worthy, from this standpoint, of more detailed examination.

Summary.

1. The substance in cell-walls to which their proteid reactions are due is not protein, at least peptonizable protein, because the reactions come off as well after peptonization as before: neither is it tyrosin, since, after soaking in hydrochloric acid, the proteid tests are got just as before.

2. Krasser's list of bodies reacting like proteids is not exhaustive, for the three reactions given by cell-walls are also given by a solution of catechu. Moreover, the copper sulphate

and caustic potash, and Gnezda's test for proteids, which fail with cell-walls, fail too with catechu.

3. The behaviour of lignified cell-walls to various reagents proves the existence in them of an iron-greening tannin: this is confirmed by the similar action of various staining fluids upon tannin in the plant and upon the cell-walls. In the meristem of the stem of *Isoëtes lacustris* there is an iron-greening tannin, while an iron-blueing tannin shows itself in the Dog-Rose—best in the collenchyma. The hard bast of the Fig has in its walls a glucoside (possibly an iron-greening tannin) to which some peculiar reactions are to be referred.

4. That the proteid and other reactions of cell-walls depend upon the presence therein of glucosides can sometimes be proved; but in the case of ordinary lignified walls this is rendered difficult by the appearance, in them, of a red colour on boiling with dilute hydrochloric acid. This red colour is probably some decomposition-product of an iron-greening tannin, for a similar colour is got when a solution of catechu is boiled with dilute acid.

5. The failure of the cell-walls to take up carmine and aniline-blue is what should not happen supposing them to contain proteid. But no form of tannin will take up carmine in the plant, and iron-greening tannin will not stain with aniline-blue.

6. The presence of glucoside in lignified cell-walls may possibly give to them their property of conducting fluid, *à propos* of Haberlandt's discovery of a glucoside as the osmotically active substance in *Mimosa pudica*. In meristems the fundamental tissues and soft bast tannin is probably transmigratory.

7. The precisely similar colour taken with methyl-green by lignified cell-walls and by the nucleus suggests the possibility of an iron-greening tannin being present in the latter.

8. It is doubtful whether proteids occur in the latex of the Fig, since the proteid reactions yielded by it may well be due to an iron-greening tannin, the presence of which in latex is proclaimed by a number of tests besides those by which proteids are known.

A Revision of Colenso's Hepaticæ, with Descriptions of New Species collected by him. By F. Stephani. (Communicated by W. T. Thiselton Dyer, C.M.G., F.R.S., F.L.S.)

[Read 18th February, 1892.]

(Plates XXVI.–XXVIII.)

The following Revision comprises a large number of Hepaticæ, collected by W. Colenso, Esq., F.R.S., and published by him in the 'Transactions' of the New Zealand Institute; they all come from the Northern Island, and being collected during a long course of years and at different stations, give a fair idea of the flora of Liverworts in this part of the country.

Of many species represented in this collection, a great number of specimens have been sent to me; they contain a valuable assortment of forms, such as can be procured only by a long residence, and by an indefatigable collector like Mr. Colenso, who appears to have been always on the hunt for new forms, never overlooking the smallest specimen if it appeared to differ from the common form. While this has contributed to raise the value of the collection, it has given him also occasion to create a number of new species, which have turned out to be only varieties of known plants and have had to be reduced. I shall give a list of them at the end of this paper.

A large number of specimens had not been named; I have tried to determine them, and have found the following new species amongst them, viz.:—

1. Aneura æquitexta, *Steph.*, sp. n.

Monoica, pusilla, viridis, in cortice gregarie crescens, gracilis. Frondes irregulariter divisæ, arcte repentes; truncus angustus 1–2 cm. longus, rami ramulique æquilatæ, breves, lobuliformes, omnes 8–9 cell. crassi, antice plani, postice leniter convexi, *cellulis æquimagnis ædificati*, margine ipso obtuso 3 cell. crasso. Calyptra clavata, basi 7 cell. apice 3 cell. crassa, superne cellu-loso-tuberculata, mamilla apicali nulla. Capsula in pedicello longiore anguste ovalis, usque ad basin quadrivalvis, sporæ 0·012 mm. brunneæ, cuticula lævi. Elateres in apice valvarum persistentes, fibra spirali singula instructi, longitudine variabili. Amenta mascula linearia, alveolis 9–10-jugis.

In most species of *Aneura* the central cells are larger than those of the cortical layer. *Aneura æquitexta* is one of the few exceptions to this rule. The large tropical species of *Aneura*

have a remarkably prolonged growth, not only in length, but also in thickness of stem and branches, such as is not observed in any other genus of Hepaticæ. In *Plagiochila*, for instance, new plants springing from the creeping axis have stems of a thickness which is variable in different species, but never changing during lifetime; in *Aneura fucoides*, on the contrary, the thickness of the stem, similar to our forest trees, is continually increasing with advancing age; while we can fix the number of stem-cells found in a transverse section of *Cephalozia* or *Lejeunea*, it is often impossible to do so in *Aneura*—a great drawback for a trustworthy description.

2. Aneura Colensoi, *Steph.*, sp. n.

Dioica, majuscula, gracilis, flavo-virens vel olivacea, laxe depresso-cæspitosa. Frondes 2–3 cm. longæ, planæ, regulariter bipinnatæ, circumscriptione oblongæ; truncus 1 mm. latus, basi stoloniferus, rami dimidium angustiores, pinnulæ angustissimæ, omnes in sectione plano biconvexi. Cellulæ corticales 0·020 mm., centrales multo majores, quadristratæ, *cuticula cellulis magnis erectis acutisque hirta.* Flores feminei in ramulis brevibus decurvis canaliculatis, margine cellulis conicis obsitis.

A most beautiful plant, entirely covered with large conical cells, the walls of which are thickened at the apex.

3. Aneura dentata, *Steph.*, sp. n.

Sterilis; dilute olivacea, robusta, in cortice terraque repens. Frons usque ad 7 cm. longa, in latas plagas prostrata, irregulariter multiramosa, plana, lobis latis pinnatim lobulatis, lobuli breves rotundati apice cellulis acutis prominentibus dentati, dentes in margine vetustiore evanidi; in sectione ubique fere æquicrassa (6 cellulas) margine ipso solum attenuata. Flores ignoti.

If it had not been for the size of the plant and the remarkably dentate margin of the younger lobes, I should not have named these sterile specimens; they are certainly different from *Aneura alterniloba*, which, being a very common New Zealand plant and abundantly represented in Colenso's collection, can be recognized at once by the almost spiny calyptra. It is described (Hook. f., 'Handbook of the N. Z. Flora,' p. 543) as having the margin of the frond minutely and remotely toothed, which I have not seen in any of the specimens sent.

4. Aneura oppositiflora, *Steph.*, sp. n.

Monoica, pusilla, cæspitosa, olivacea, rigidula. Frondes 1–2 cm. longæ, basi decumbentes dein erectæ, irregulariter divisæ, ubique plano-biconvexæ; cellulæ corticales 0·017 mm., axiales irregulares multo tamen majores bi-tristratæ. Ramuli feminei versus apicem plantæ ad basin pinnularum oppositi, breves, margine cellulis magnis papulosis ornati. Antheræ pinnularum inferiorum basi impositæ (*i. e.* pinnulæ apice vegetativæ), alveoli 4–5-jugi.

In size and general appearance very much like *Aneura perpusilla*, Col., which is also monoicous, but differs by an almost terete trunk and pinnules with a plane antical and a very convex postical side; the cortical and central cells are, besides, of equal size throughout.

5. Aneura striolata, *Steph.*, sp. n. (Pl. XXVI. figs. 1–3.)

Dioica, parva, fusco-brunnea, cæspitosa, humilis. Frondes 1–2 cm. longæ, e caudice repente adscendentes (vel inter muscos erectæ) simplices vel remote paucipinnatæ, lineares vel propter apicum bifurcationem dilatatæ, pinnulæ superiores breves, inferiores descendentes in flagella radicantia mutatæ; antice planæ, postice leniter convexæ, margine acuto. Cellulæ corticales parvæ (0·020 mm.), centrales biseriatæ multo majores. *Cuticula lamellis minutis confluentibus striolata* margineque iisdem lamellis prominentibus minute denticulata. Amenta mascula ad basin frondis, singula vel ramulo furcato geminata, oblongo-linearia, alveolis 4–5-jugis.

The lamellæ on the surface of the cells can only be seen with a good instrument, and with a power of at least 500 diam. In younger cells they appear not to be developed, or are not discernible without staining.

6. Anthoceros arachnoideus, *Steph.*, sp. n.

Dioica, flavo-virens, in cortice putrescente arcte repens. Frons 1–2 cm. longa, plana ex angusta, basi late obovata, paucilobata, carnosa (medio 8 cellulas crassa), marginem versus sensim attenuata, solida, *i. e.* haud cavernosa, margine maxime breviterque lacerata, *supra cristis humilibus coalescentibus laceratis instructa.* Antheræ in fronde dispersæ, in alveolis amplis *singulæ*, stipite sexcellulari. Cetera desunt.

There are several species of *Anthoceros* known which have similar crests on the antical surface of the frond. In *Anthoceros punctatus* they are reduced to small remote scales scattered over

the frond. In *Anthoceros arachnoideus* they form a regular network, and the dry plant looks as if overrun by a small *Cephalozia*.

Our European species have geminate antheræ; in *A. dilatatus*, Steph., from Fernando Po, we find them as many as 20 in each cavity. This variability is quite exceptional in Hepaticæ, which are distinguished by very constant numbers of reproductive organs within the range of a genus and even of a tribe.

7. ANTHOCEROS LAMINIFERUS, *Steph.*, sp. n.

Monoica, olivacea, siccando subnigra, plagas orbiculares 4 cm. in diametro formans. Frondes *adscendentes*, in centro radicantes, *in lacinias lacinulasque numerosas sensim dissolutæ*, basi distincte costatæ et fere ad costam reductæ, *crassæ*, *cavernosæ*, antice planæ, postice valde convexæ; laciniæ minus distincte costatæ minusque cavernosæ, costæ cum alis tenuibus sensim confluentes; *superficies antica lamellis longis tenuibus percursa*, laciniæ ultimæ lanceolatæ *marginibus* crispatis. Involucra singula, cylindrica, ore haud angustata, parietibus crassis cavernosis. Capsula 3 cm. longa. Pseudoelateres breviarticulati. Sporæ nigræ, 0·035 mm., denseque papillosæ. Antheræ geminatæ, in alveolis costæ impositæ.

If a section of the main axis of this plant be taken off and cut into a series of transverse sections, it is easy to see that the stout costa of the base undergoes a bifurcation and runs out by repeated forking into all the laciniæ; these branches are held together by a thin lamina, that is, the costa forks long before the frond becomes visibly bipartite; this can be seen also in *Symphyogyna* and *Metzgeria*. There can be no doubt that *Anthoceros* has a dichotomous mode of branching which is rarely perceptible. I may add that our plant is certainly no *Dendroceros*, the midrib of which is much more pronounced.

8. ANTHOCEROS PALLENS, *Steph.*, sp. n.

Monoica, flavicans vel dilute olivacea, in cortice putrescente arcte repens. Frondes 3–4 cm. longæ, læves, oblongæ, inæqualiter lobatæ, lobis rotundatis, ubique 5 cellulas crassæ, *laxe cavernosæ*, *superficie itaque sub lente reticulata*. Involucra *oblongo-fusiformia*, pariete basi 12 cellulas, apice 1 cell. crassa, cellulis irregulariter prominentibus quasi aspera. Capsula 4 cm. longa, robusta, *flavo-rubescens*, valvulis post dehiscentiam planis neque tortis, haud raro uno latere solum fissa. Elateres fibra laxe torta

repleti, pallide flavescentes. Sporæ 0·025 mm., dense verrucosæ, flavescentes. Antheræ in alveolis magnis geminatæ.

Species of *Anthoceros* are rather common all over Europe, and easily found in all stages of development; it is therefore scarcely necessary to state that young involucra are closed at the top, and later on ruptured by the protruding capsule, leaving an irregular lacerate opening, parts of which are torn away or remain adhering as scarious rudiments. The old authors have taken great care to describe these broken tissues as teeth or lips &c., and tried to find specific differences in what is naturally of quite accidental origin.

If a well-developed capsule of *Anthoceros* be taken out of the frond with the basal bulb adhering, and split open from top to bottom, spores and elaters in all stages of development will be found, ripe at the top, the youngest and least developed at the base; the walls of the capsule keep pace with the development of its contents, and the valves are firmly united at the base and still green. This lower part of the capsule has been often described as a pedicel, which certainly is not correct. This presumptive pedicel is called sometimes "long exserted" or "included," which of course means nothing more than the more or less advanced ripeness of the capsule, and can be of no diagnostic value.

9. Harpalejeunea Colensoi, *Steph.*, sp. n. (Pl. XXV. figs. 6–9.)

Dioica, pusilla, in cortice dense depresso-cæspitosa, pallide virens. Caulis 1 cm. longus, vage pauci-ramosus, rami simplices vel pinnulis remotis instructi. Folia dissita, e basi turgida ovato-triangularia acuta vel cuspidata, acumine decurvo-uncinato, antice caulem angulatim superantia; lobulus folio duplo brevior, curvato-semiovatus, inflatus, carina papulosa, abrupte in folii marginem exeunte, apice truncatus, angulo acuto. Amphigastria foliis parum minora, remota, transverse inserta usque ad medium biloba, sinu recto obtuso, lobis ovato-oblongis muticis. Flores feminei in caule terminales utroque latere innovati; folia floralia caulinis multo majora, erecta, ovata, apice acuta, incurvata, lobulus parum brevior, semiovatus, margine postico replicato; amphigastrium florale obovatum ad $\frac{1}{5}$ incisum, sinu acuto lobisque rotundatis. Andrœcia ignota. Folii cell. $0{\cdot}017 \times 0{\cdot}012$ mm.

Not larger than *Lejeunea minutissima*, and somewhat resembling *Harpalejeunea subfenestrata*, Massal., of Cape Horn.

10. Lopholejeunea Colensoi, *Steph.*, sp. n. (Pl. XXVI. figs. 4, 5.)

Dioica, pusilla, vix rufescens, in cortice laxe cæspitans vel persæpe muscis hepaticisque mixta. Caulis 2 cm. longus, vage ramosus. Folia recte patentia vix imbricata, late ovata, apice rotundata; lobulus folio $\frac{1}{3}$ brevior, *oblongo-cylindricus*, *apice maxime saccatus*, i. e. a caule recte patens strictus inflatusque, dein *subito saccatim adscendens et cum incisura acutissima abrupte* in folii marginem transiens, cellulæ 0·017 mm. ipsa basi 0·025 mm. trigonis nullis nisi ad basin folii. Amphigastria fere rotunda si basin transversam excipis, caule quintuplo latiora, plano-appressa, integra. Perianthia in ramulis terminalia innovatione nulla, turbinata, compressula, 4-carinata, carinæ *squamulis ovato-oblongis linguæformibus hamatimque patulis vestitæ*. Folia floralia bijuga, intima foliis caulinis duplo majora, integerrima, lobo duplo breviore, lineari. Amphigastria florale e basi cuneata, subrotunda, integra. Andrœcia longissima, bracteis multijugis (10–18).

This is one of the most remarkable plants of Colenso's gathering; I had found many years ago sterile plants mixed with other New Zealand Hepaticæ, but was uncertain as to their affinity, the shape of the lobule being very different from that of other *Lejeuneæ*. The small size of the plant and the absence of nearly all rufous colour remove it somewhat from the rest of *Lopholejeunea*, to which it, however, doubtless belongs on account of its perianth, which in place of the usually lacerated marginal wings has flat leafy scales, somewhat hooked at apex; the upper half of the perianth is bristling with them.

11. Pycnolejeunea glauca, *Steph.*, sp. n. (Pl. XXVIII. figs. 18–21.)

Monoica, parva, in cortice laxe cæspitans, glauca. Caulis 1–2 cm. longus, dense pinnatim multiramosus, ramulis inæqualibus furcatis vel longioribus simplicibus. Folia fere recte patentia, ovata, antice caulem haud superantia; lobulo duplo breviore, inflato, carina arcuata, margine supero carinæ parallelo extus oblique truncato, angulo acuto. Cellulæ marginales 0·008, medio 0·017, ipsa basi $0{\cdot}017 \times 0{\cdot}025$ mm., trigonis acutis majusculis, cuticula aspera. Amphigastria magna, appressa, caule quadruplo latiora, sinuatim inserta, fere rotunda, ad $\frac{1}{3}$ incisa, lobulis rima angusta discretis acutis. Perianthia in ramulis terminalia utroque latere innovata, ovato-oblonga, quinqueplicata, plicis ventralibus usque ad basin fere decurrentibus, rostro

majusculo. Folia floralia caulinis vix majora, laxe amplectentia, lobulo magno, lanceolato-obtuso, breviter soluto; amphig. florale magnum linguæforme ad $\frac{1}{4}$ bifidum, rima angusta lobulisque acutis vel obtusis. Andrœcia in caule primario lateralia, magna, bracteis 8-jugis laxe dispositis, ad medium bifidis lobi æquales ovato-acuti.

Proxima *Pycnolejeuneæ longidenti* et *curvatilobæ*, Steph. (Hedwigia, 1889, p. 260).

12. Lophocolea erectifolia, *Steph.*, sp. n. (Pl. XXVII. figs. 12–15.)

Dioica, flavo-virens, laxe cæspitosa, majuscula. Caulis 2–4 cm. longus, crassus, vage pauciramosus, ramis sterilibus simplicibus elongatis procumbentibus, fertilibus brevibus adscendentibus. Folia opposita, postice stipulis coalita, basi antica libera, conferta, basi ad dimidium imbricata, apice libera, late ovato-triangularia, apice plus duplo angustiora, profunde emarginato-bidentata, dentibus inæqualibus (supero majore) acutis, e basi erecta decurvula, marginibus convolutinis, juniora magis adscendentia, fere erecto-accumbentia. Cellulæ 0·025 mm., æquales, angulis parum incrassatis. Amphig. foliis vix duplo breviora, circumscriptione reniformi, a caule oblique patula, ad medium grosse quadrifida, laciniis utroque latere per paria approximatis foliisque alte connatis. Flores feminei in ramulis brevibus terminales utraque latere innovati; bracteæ quadrijugæ, interiores foliis majores apice longius bidentatæ, margine postico grosse quadridentatæ, cum bracteola quadridentata, latissime coalitæ. Perianthia parum emersa, ore breviter trilobata, lobis aliisque grosse laciniatis, laciniis lanceolatis integris. Andrœcia in medio caulis, bracteis confertis 4–6-jugis, foliis multo minoribus erecto-decurvis, antice lobulo ovato inflato longe dentato instructis.

Lophocoleæ triangulifoliæ (quæ sequitur) peraffinis; hæc differt colore, foliis plano-distichis, apice multo magis angustatis, cellulis haud incrassatis stipulisque profundius fissis, setaceo-laciniatis.

13. Lophocolea filicicola, *Steph.*, sp. n. (Pl. XXVII. fig. 10.)

Sterilis, tenera, gregarie crescens, flavo-virens. Caulis 6–8 cm. longus, vage pauciramosus, in cortice arcte repens (in trunco Filicum). Folia alternantia, per paria tamen approximata parum imbricata, recte a caule patentia, plano-disticha, ovato-rectangularia, basi antica libera, postice amphigastriis uno vel utroque latere coalita, apice parum angustata, lunatim excisa,

bidentata, laciniis acuminatis acutis porrectis, margine postico persæpe parvo dente munito. Cellulæ marginales 0·017, reliquæ 0·025 mm., trigonis distinctis. Amphigastria bifida, *laciniis setaceis maxime divaricatis*, sinu levissimo discretis, extus dente plus minus longo munitis, ad basin utroque latere lacinia retrospectante *optime hastatim setacea*. Cetera desunt.

It is most difficult nowadays to publish a new *Lophocolea* or *Chiloscyphus*, the old descriptions being so short as to make it often impossible to recognize the plants; it is much to be wished that some English botanist would go to Kew and give us detailed descriptions and good figures of all species contained in that vast collection. These two genera want it more than any other genus of Hepaticæ.

14. Lophocolea triangulifolia, *Steph.*, sp. n. (Pl. XXVII. fig. 11.)

Sterilis, pallida, in cortice longe lateque repens. Caulis 4–5 cm. longus vage ramosus. Folia dense imbricata, plano-disticha, opposita, basi antica libera, *trianguliformia*, e basi latissima versus apicem maxime angustata (*apice sextuplo angustiora*) ipso apice breviter emarginata, sinu obliquo plus minus angusto, dentibus inæqualibus (ventrali minore) breviter acuminatis acutis, *versus apicem plantæ spectantibus*. Cellulæ marginales 0·025, reliquæ 0·035 mm., angulis haud incrassatis nisi ad basin foliorum. Amphigastria majuscula cauli accumbentia utroque latere foliis limbo angusto connata, usque ad basin fere quadrifida, laciniis lanceolato-subulatis, divaricatis.

A well-distinguished species; the leaves are so broad at the base, that each covers the base of the next two above and below, four in all. The only species to be compared is *Lophocolea tasmanica*, Mitten, the leaves of which are more slender and the stipules of a very different shape.

15. Pallavicinia connivens, *Steph.*—Symphyogyna connivens, *Colenso*, *Trans. N. Z. Inst.* xx. p. 254.

Dioica, minor, flavescens, gregarie crescens. Caulis (*i. e.* frondis pars inferior exalatus) e caudice repente erectus, 2 cm. longus, fusco-purpureus, fasciculo brunneo cellularum elongatarum percursus, apice anguste alatus abrupte in frondem dilatatus. Frons reniformis valde carnosa, marginibus erectis conniventibus vel involutis, costa bis vel ter dichotoma ubique lamina tenera connata, apice solum inter costas emarginata et plicato-crispula,

margine grosse dentata. Cellulæ superficiales 0·025, basi ipsa 0·025 × 0·070 mm. Flores feminei in frondis facie antica primæ bifurcationi impositi. Involucrum tubulosum, carnosum, apice laciniatum, laciniis inæqualibus lanceolatis acuminatis; pistilla 6–8. Perianthium juvenile annuliforme, ore dentato.

The cylindric involucre distinguishes this plant at once from *Symphyogyna*, the pistils of which are merely covered by a scale, free at the sides and inserted on the frond by its base alone, so that it can be turned backwards without a rupture. *Hymenophyton*, Dum., *Podomitrium*, Mitten, and *Umbraculum*, Gottsche, have the flowers on postical branches.

Each of these three genera presents two very different vegetative forms, viz.:—

a. *The creeping form*, as in *Hymenophytum phyllanthus*, *Symphyogyna brasiliensis*, and *Pallavicinia Lyellii*.

b. *The dendroid form* with an erect pedicel and a more or less umbelliform frond at apex, as in *Hymenophytum flabellatum*, *Symphyogyna hymenophyllum*, and *Pallavicinia connivens*.

Dr. Gottsche (in Ann. Sc. Nat. sér. 5, i. 1862, p. 177) created a new genus, *Mittenia*, differing from *Pallavicinia* (*Blyttia*) by the calyptra adhering to the base of the perianth. I have not seen his plant; but if there is no other difference, a separation from *Pallavicinia* is scarcely justified. In a flower of *Pallavicinia Lyellii* we find the pistils at the base of the young calyptra; later on they are found scattered over its surface, a consequence of the growth of those cells which surround it at the base and on which the pistils are inserted. A more enlarged activity of the basal cells and a participation of the whole torus pistillorum will at once bring the calyptra to adhere to the perianth.

If, therefore, we separate *Mittenia* from *Pallavicinia*, we merely mark the *intensity* of a process which is going on in both.

Symphyogyna Hymenophyllum var. *heterogena* of Spruce (in Trans. Bot. Soc. Edinb. xv. (1884) p. 536) is probably a *Pallavicinia* too ("flores stipite perbrevi valido carnoso suffulti," which reads like the thick base of a young cylindric involucre).

16. Radula grandis, *Steph.*, sp. n. (Pl. XXVIII. figs. 16, 17.)

Sterilis, flavo-virens, robusta, flaccida. Caulis 4–5 cm. longus, vage multiramosus, ramulis regulariter pinnatis, pinnulis remotis brevibus. Folia magna, dense imbricata, semicordato-ovata,

falcata, apice valde recurvata, antice caulem parum superantia; carina leniter arcuata, oblique a caule patens (angulo 45°), sinu profundo in folium excurrens. Lobuli maximi, imbricati, inflati, ovati, supra caulem protracti, apice obtusi vel rotundati. Cellulæ marginales 0·008, reliquæ 0·017 mm., angulis parum incrassatæ. Reliqua ignota.

This is a beautiful species and one of the stoutest, resembling smaller forms of *Porella Stangeri*; its nearest ally is *Radula recurvifolia*, Steph. (Hedwigia, 1888, from Mt. Kilimandjaro), which has flat subquadrate lobules. There is no similar *Radula* known from New Zealand or Australia, and the very large imbricate lobulus will at once distinguish it from *Radula physoloba* and *plicata*.

17. Radula papulosa, *Steph.*, sp. n.

Dioica, viridis, supra muscos repens, majuscula. Caulis 4–5 cm. longus, ab ipsa basi multiramosus, ramis dense regulariterque pinnatis. Folia imbricata, oblique a caule patentia (angulo 70°) fere rotunda, concava, apice recurvula, lobulo duplo breviore, fere quadrato cauli parum incumbente, angulo apicali obtuso, carina fere stricta. Cellulæ 0·017 mm., incrassatio angulorum fere nulla; *cellulæ folii anticæ et marginales papulosæ*.

This is perhaps the plant described in Hooker's 'Handbook of N. Z. Flora' as *Radula complanata*, to which it bears great resemblance; the dioicous flowers and the papulose cells are such well-marked differences, that it cannot be confounded with any other New-Zealand species of *Radula*.

18. Tylimanthus spinosus, *Steph.*, an sp. propria?

This is perhaps only a curious variety of the very variable *Tylimanthus tenellus*. While the leaves of the last are unequally bilobed, the antical lobe being smaller, dentiform, the postical obtuse and coarsely dentate, our plant has *entire* leaves with 6 to 8 spiny teeth, consisting of a single row of 3 to 4 cells with very thick walls. The general appearance and the fragility of the plant is very much like that of *T. tenellus*. Fruiting specimens will perhaps justify its separation as a proper species.

Massalongo's *Adelanthus*? *brecknockiensis* is probably a *Tylimanthus*; the figure given in 'Nuov. Giornale Bot. Ital.' vol. xvii. tab. 27, looks very much like *Tylimanthus tenellus*. It cannot be an *Adelanthus*, as a fully developed, though sterile, flower of this genus cannot be found without a perianth.

List of New Species which, from the examination of specimens sent to Kew, appear valid.

Aneura perpusilla, *Col.*
,, marginata, *Col.*
,, polymorpha, *Col.*
,, nitida, *Col.*
Anthoceros pellucidus, *Col.*, ? sterilis.
Chiloscyphus ammophilus, *Col.*
,, lingulatus, *Col.*
,, vulcanicus, *Col.*
Gottschea guttata, *Col.*
,, marginata, *Col.*
,, heterodonta, *Col.*
,, ramulosa, *Col.*
,, squarrosa, *Col.*
Isotachis montana, *Col.*
Lepidozia concinna, *Col.*
Madotheca amœna, *Col.*
Mastigobryum elegans, *Col.*
,, nitens, *Col.*
Plagiochila subfasciculata, *Col.*
Symphyogyna brevicaulis, *Col.*
,, flavo-virens, *Col.*
,, connivens, *Col.* (*Pallavicinia connivens*, Steph.).

There are a number of other species published of which no specimens have been received.

List of reduced Species.

Aneura epibrya, *Col.*	is A. alterniloba, *Hook. et Tayl.*
Balantiopsis glandulifera, *Col.*	,, B. diplophylla, *Mitt.*
Chiloscyphus compactus, *Col.*	
,, epibryus, *Col.*	,, C. coalitus, *Nees.*
,, Spruceanus, *Col.*	
,, dicyclophorus, *Col.*	,, C. cymbaliferus, *Hook. et Tayl.*
,, insulus, *Col.*	,, C. ammophilus, *Col.*
,, epiphytus, *Col.*	,, Lophocolea biciliata, *Mitt.*
,, involucratus, *Col.* ...	
,, marginatus, *Col.*	,, L. heterophylloides, *Nees.*
,, montanus, *Col.*	,, Balantiopsis diplophylla, *Mitt.* (1).*
Fossombronia macrophylla, *Col.* ...	
,, gregaria, *Col.*	,, Noteroclada porphyrorhiza, *Nees.*
,, nigricaulis, *Col.*	
,, rosulata, *Col.*	
Frullania scabriseta, *Col.*	,, F. deplanata, *Mitt.*
, implexicaulis, *Col.*	

* See Annotations, pp. 276, &c.

Frullania Banksiana, *Col.*	is F. pyncnantha, *Hook. et Tayl.* (2).
,, diffusa, *Col.*	
,, echinella, *Col.*	
,, Cunninghamiana, *Col.*	,, F. squarrosula, *Hook. et Tayl.*
,, pulvinata, *Col.*	
,, viridis, *Col.*	
,, ichthyostoma, *Col.*	
,, rotundifolia, *Col.*	
,, minutissima, *Col.*	,, F. falciloba, juvenilis, *Hook. et Tayl.*
,, delicatula, *Col.*	
,, minutissima, *Col.* (another specimen)	,, F. rostrata, *Hook. et Tayl.*
,, Solanderi, *Col.*	,, F. cranialis, *Tayl.*
,, Novæ-Zelandiæ, *Col.*	,, F. Hampeana, *Nees.*
Gottschea lætevirens, *Col.*	,, G. marginata, *Col.*
,, nitida, *Col.*	
,, truncatula, *Col.*	
,, trichostoma, *Col.*	
,, simplex, *Col.*	
,, longiciliata, *Col.*	
,, ciliistipula, *Col.*	
,, epiphyta, *Col.*	
,, dichotoma, *Col.*	,, G. squarrosa, *Col.*
,, Winkelmannii, *Col.*	,, G. appendiculata, *Nees.*
,, moniliformis, *Col.*	
,, longiseta, *Col.*	,, G. heterodonta, *Col.*
,, clandestina, *Col.*	
,, heterocolpos, *Col.*	
,, gregaria, *Col.*	
,, laciniosa, *Col.*	
,, macroamphigastriata, *Col.*	
,, flavo-virens, *Col.*	
,, pallescens, *Col.*	
,, plumulosa, *Col.*	,, G. pinnatifolia, *Nees.*
,, chlorophylla, *Col.*	,, G. ciliata, *Mitt.*
Isotachis elegans, *Col.*	,, I. montana, *Col.* (5).
,, rosacea, *Col.*	,, I. Lyallii, *Mitt.*
,, Mitteniana, *Col.*	,, Lophocolea leucophylla, *Tayl.*
Jungermannia geminiflora, *Col.*	,, J. monodon, *Hook. et Tayl.* (Anastrophyllum).
,, consimilis, *Col.*	
,, rufiflora, *Col.*	,, J. inundata, *Hook. et Tayl.* (Nardia) (3).
,, frullanioides, *Col.*	,, a moss.
Lejeunea epiphylla, *Col.*	,, Radula Mittenii, *Steph.*
,, ochracea, *Col.*	,, Radula physoloba, *Mont.*
Lepidozia elegans, *Col.*	,, L. centipes, *Taylor.*
,, minuta, *Col.*	,, L. prænitens, *Lehm. & Lindenb.*
,, retrusa, *Col.*	
,, latiloba, *Col.*	,, L. concinna, *Col.*

Lepidozia cancellata, *Col.*	is L. capilligera, *Lindenb.*
,, subverticillata, *Col.*	
,, minutissima, *Col.*	
,, leucocarpa, *Col.*	,, L. Lindenbergii, *Gott.*
,, occulta, *Col.*	
Lophocolea submuricata, *Col.*	,, Chiloscyphus lingulatus, *Col.*
Madotheca latifolia, *Col.*	,, M. Stangeri, *Gott.*
Mastigobryum concinnatum, *Col.*	
,, imbricatistipulum, *Col.*	
,, epibryum, *Col.*	,, M. Mittenii, *Steph.*
,, quadratum, *Col.*	
,, macroamphigastriatum, *Col.*	
,, olivaceum, *Col.*	,, M. Novæ-Hollandiæ, *Nees.*
,, polyodon, *Col.*	
,, heterodontium, *Col.*	
,, obtusistipulum, *Col.*	
,, delicatulum, *Col.*	,, M. Taylori, *Mitt.*
,, amœnum, *Col.*	
,, minutulum, *Col.*	,, M. Colensoi, *Mitt.*
,, pusillum, *Col.*	,, M. nitens, *Col.*
,, compactum, *Col.*	
,, obtusatum, *Col.*	,, M. convexum, *Lindenb.*
,, smaragdinum, *Col.*	,, some *Chiloscyphus* or *Lophocolea*, very poor.
Metzgeria flavo-virens, *Col.*	,, M. furcata, *Lindenb.*
Plagiochila subsimilis, *Col.*	,, P. Stephensoniana, *Mitt.*
,, polycarpa, *Col.*	
,, obscura, *Col.*	
,, trispicata, *Col.*	,, P. arbuscula, *Lehm. et Lindenb.*
,, longissima, *Col.*	
,, polystachys, *Col.*	
,, suborbiculata, *Col.*	,, P. gigantea, *Lindenb.*
,, Spenceriana, *Col.*	
,, cæspitosa, *Col.*	,, P. deltoidea, *Lindenb.*
,, axillaris, *Col.*	
,, recta, *Col.*	,, P. radiculosa, *Mitt.*
,, pallescens, *Col.*	,, P. Lyallii, *Mitt.*
,, flabellata, *Col.*	,, P. subfasciculata, *Col.*
,, heterophylla, *Col.*	,, P. fasciculata, *Lindenb.*
,, Berggreniana, *Col.*	
,, Parkinsoniana, *Col.*	,, P. Fenzlii, *Reichardt.*
,, alpina, *Col.*	,, P. fuscella, *Hook. et Tayl.* ?, very poor.
,, subconnata, *Col.*	,, P. convexa, *Hook. et Tayl.*
,, intermixta, *Col.*	
,, subpetiolata, *Col.*	,, Adelanthus falcatus, *Mitt.*
,, rotundifolia, *Col.*	
,, orbiculata, *Col.*	,, some *Jungermannia*, very poor and sterile.

Podomitrium smaragdinum, *Col.*	is P. phyllanthus, *Mitt.* (4).
Polyotus fimbriatus, *Col.*	„ P. Taylori, *Gott.*
„ prehensilis, *Col.*	
Psiloclada digitata, *Col.*	„ Lepidozia Gottscheana, *Lindenb.*
Radula albipes, *Col.*	„ Lejeunea nudipes, *Tayl.*
„ xanthochroma, *Col.*	„ R. physoloba, *Mont.*
Sendtnera quadrifida, *Col.*	„ Lepicolea attenuata, *Mitt.*
Symphyogyna platycalyptra, *Col.*	„ S. flabellata, *Mont.* (4).
„ platystipa, *Col.*	„ S. leptopoda, *Hook. et Tayl.*
„ crispula, *Col.*	„ S. Hymenophyllum, *Mont.*
Tylimanthus novæ zelandiæ, *Col.*	„ T. saccatus, *Tayl.*
„ perpusillus, *Col.*	„ T. tenellus, *Hook. et Tayl.*
Trichocolea elegans, *Col.*	„ T. tomentella, *Nees*, forma minor.
Zoopsis basilaris, *Col.*	
„ flagelliformis, *Col.*	„ Z. argentea, *Hook. et Tayl.*
„ muscosa, *Col.*	
„ lobulata, *Col.*	„ Aneura perpusilla, *Col.*

Annotations.

(1) BALANTIOPSIS DIPLOPHYLLA.—This plant is said to have been found also in Peru, from where it is reported under the name of *Ptilidium cancellatum*, Nees, in Synopsis Hepat. p. 252. I have examined the original specimen, which is identical with New-Zealand and Australian specimens; it is very improbable that this plant should have been found on the mountains of Peru, and I suspect some mistake in the name of the country. Both names having been given in 1844, the right of priority depends upon a difference of months only, which I am unable to find out, and if found would not induce me to change Taylor's name.

(2) FRULLANIA PYCNANTHA.—There have been two forms sent of very different appearance, the normal one growing in places exposed to sunlight, stout and tough, very dark, in a dry state almost black and horny, lobules well developed and hooked, large. A common variety of it is the original specimen of Taylor, flaccid, quite green, lobules small, growing in dark forests. The perianths and floral leaves of both forms do not show any differences.

The same may be said also of *Frullania squarrosula*, and, *mutatis mutandis*, of all *Frullaniæ*; the leaf-lobule (auricle) is folded in if the plants grow in dry atmosphere, and is unrolled or reduced in size and form if they grow in wet and misty localities. This may be observed also in our European species. The leaf-lobule is a water-sac, which is well developed in dry localities, and becomes useless in a damp atmosphere.

The stylus (at the postical insertion of the leaf-lobule), which can be found, with rare exceptions, in every *Frullania*, and may be traced also in the female bracts as a more or less conspicuous tooth or lacinia at the base of the postical margin, is sometimes developed into a large lanceolate leaf overlying the cucullate auricle or leaf-lobule. This variability leads to the conclusion that the said stylus is nothing but a reduced lacinia of the leaf-lobule. I have the authority of Dr. Spruce in support of this view (see Trans. Bot. Soc. Edinb. xv. (1884) p. 3). The stylus springs from the base of the lobule, just as in *Cololejeunea*, the only difference being that in the last it is free; in *Frullania*, however, more or less *connate* to the leaf-lobule. In both, the stylus is certainly part of the leaf, and stands in no relation whatever to the stipules. Mr. Pearson, in his last paper on Canadian Hepaticæ, has given expression to the opinion that in *Cololejeunea* the stylus is the remnant of a normally bifid stipule. I may be allowed to differ from this view. *Cololejeunea*, though having no stipules, produces radicles on exactly the same places where in other *Lejeuneæ* stipules are found; in *Cololejeunea* the latter have disappeared, the rootlets, which always spring from the base of the stipules in *Lejeunea*, alone remain, and point out the place where stipules once stood. This place, however, is as far away from the stylus folii in *Cololejeunia* as stipules are in *Frullania*; and no relation between the two organs can be established. Certainly an organ cannot be called a remnant of another if they do not spring both from the same spot.

(3) NARDIA INUNDATA.—This is a good species of *Nardia* of the section of *Eucalyx*, Lindb., and very similar to our European *Nardia obovata*, having the perianth deeply immersed and the free part of the female bracts horizontally patent.

(4) HYMENOPHYTUM.—This genus was founded by Dumortier on *Jungermannia flabellata* and *J. Hymenophyllum*; the last is a true *Symphogyna*, having the female flower *on the antical side* covered by a small scale; it springs from the very point where the midrib forks, and is inserted just above the central fascicle of brown cells. The antheridia, covered by similar small scales, stand in a long row on the antical side of distinct plants. I have been able to examine Hooker's original plant.

Jungermannia flabellata alone is therefore the type of Dumortier's genus *Hymenophyton*, which has the flowers, male and

female, inserted on small *postical* branches which do *not* spring from the centre of the midrib, but *sideways* on it, and have an axis which stands *at right angles* to that of the parental frond. The ramification is therefore a *lateral* one; if these plants were not frondose Hepaticæ provided with an unbroken wing in place of leaves, this would have been recognized long ago. *Hymenophytum phyllanthus*, which has a creeping undivided frond, is best adapted to study the origin of these fertile branches.

H. flabellatum, which has a dichotomous frond, is sometimes described as having the flowers (instead of saying branches) springing *from the forks*. This is not the case; the midrib is dividing *before* fertile branches are developed, which stand *in the angle of the forks*, distant from the brown central fascicle of the midrib, in which they materially differ from *Symphogyna* and all other frondose Hepaticæ, *Metzgeria* excepted. This last genus, though differing much in general appearance, is nevertheless the nearest ally of *Hymenophytum*; for *Metzgeria*, too, has *lateral* fertile branches (the sterile postical branches spring also from the *side* of the midrib in both), on the antical side of which pistillodia and antheridia are inserted; both have a midrib with an axial fascicle of long and narrow cells; in both genera the female flower is protected by an annular depressed involucre which surrounds the young flower and becomes bivalved in *Hymenophytum*; while in *Metzgeria* only the apical valve is well developed, the postical part consisting of a semi-annular row of cells.

This involucre is closely united with the little branch on which it is inserted; so that only longitudinal sections will give a view of all this.

In *Metzgeria* I have seen it most clearly on a species from Australia (*M. australis*, Steph. in Hedw. 1889, p. 266). More of this can be found in my paper on "Hepaticæ Australiæ," in the place cited.

Of *Hymenophytum* three species are known, viz. *H. flabellatum*, *leptopodum*, and *phyllanthus*. Dr. Schiffner, in the Botany of the 'Gazelle' Expedition, published a fourth one (*Podomitrium majus*), of which he has examined a fruiting or flowering specimen. His description of the vegetative organs ends with the remark: "Involucrum femineum ut in *Podom. phyllanthus*."

This is rather scanty for a plant to which he has given a new name, and of which certainly as much of a detailed description

was to be expected as the specimen will allow, particularly of sexual organs.

(5) Isotachis.—This genus, founded by Mitten, was revised by Gottsche in his 'Prodromus Floræ Novo-Granat.' (Ann. Sc. Nat. sér. 5, i. (1864), pp. 120–125), where he describes the apex of the perianth as being "veiled by dentate scales" ("apice squamulis dentatis obvelatum"). A few pages later on he says of *Isotachis serrulata* more distinctly: "ore squamulis dentatis *externe* accretis obvelato." In the German text, cited from Gottsche and Rabenhorst, 'Hepaticæ exsiccatæ' No. 272, he speaks of the young pistillidia as "surrounded by a ring of small involucral scales, *around which* the perianth is formed; while the calyptra is taking up the pistillidia, the perianth carries up the scales, so that after full development they are found *externe* accretæ."

In the diagnosis of *Isotachis Lindigiana* he furthermore states "*externe* squamis minoribus obsesso," while in the detailed description following the "Perianthium *facie interna* multas excrescentias monstrans" is described. This repeated contradiction is nowhere explained.

If thin longitudinal sections of a well-developed perianth of *Isotachis* are made, we find them to consist of several layers of cells; the *innermost* layer, which is *shorter*, can be *traced down to the base,* and runs out into a variable number of *free laciniæ.*

The *outer* layer forms what we heretofore have been used to call the perianth; it is *longer* than the internal layer, the apex of which is perfectly hidden and cannot be seen from above; the apex of the so-called perianth is split into similar irregular laciniæ, the outside smooth. This is what I have found in different species of *Isotachis.*

We have been used heretofore to call "perianth" the innermost concrete bracts surrounding the pistillidia of Hepaticæ; we call it so in *Nardia scalaris* and in *Sarcoscyphus,* both of which have short immersed perianths, embraced by much longer bracts, to which they are firmly connate, forming thereby a more or less fleshy cup; only the uppermost part of these perianths is free, and commonly split into a number of lobes.

Taking this analogy, we are compelled to call *the innermost layer* of cells in the perianth of *Isotachis* "*perianth,*" the *outer layers* "*bracts,*" which are longer and connate to the perianth, of which only the apex is free, exactly as in *Nardia* and *Sarcoscyphus.*

The union between bracts and perianth in *Sarcoscyphus* is often incomplete; there are crests or wings found inside and outside on the cup, free margins of imperfectly concrescent parts. It is possible that the outside of some perianths of *Isotachis*, though I have not seen it, bears such dentate or laciniate crests, which have given rise to the otherwise incomprehensible contradictions mentioned above.

EXPLANATION OF THE PLATES.

Plate XXVI.

Aneura striolata, Steph.

Fig. 1. Entire plant. ×7.
2. Transverse section of axis. ×40.
3. Cell, with lamellæ. ×500.

Lopholejeunea Colensoi, Steph.

Fig. 4. Part of plant. ×33.
5. Perianth. ×33.

Harpalejeunea Colensoi, Steph.

Fig. 6. Part of plant. ×60.
7. Leaf, flattened. ×100.
8. Stipule. ×500.
9. Female flower. ×60.

Plate XXVII.

Lophocolea filicicola, Steph.

Fig. 10. Part of plant. ×12.

Lophocolea triangulifolia, Steph.

Fig. 11. Part of plant. ×12.

Lophocolea erectifolia, Steph.

Fig. 12. Leaves with stipule, flattened. ×20.
13. Perianth. ×15.
14. Innermost female bracts. ×15.
15. Male bracts. ×40.

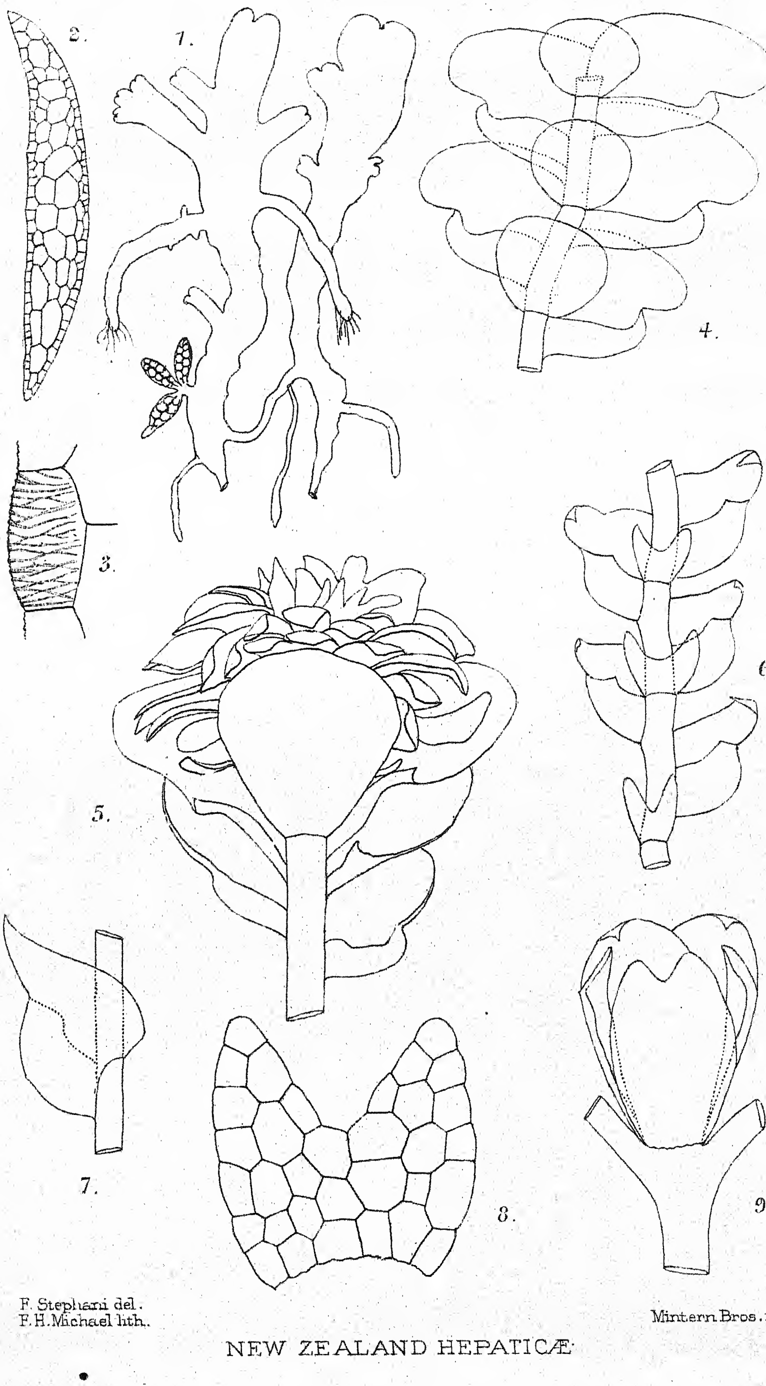
Plate XXVIII.

Radula grandis, Steph.

Fig. 16. Part of plant. ×24.
17. Leaf, flattened. ×24.

Pycnolejeunea glauca, Steph.

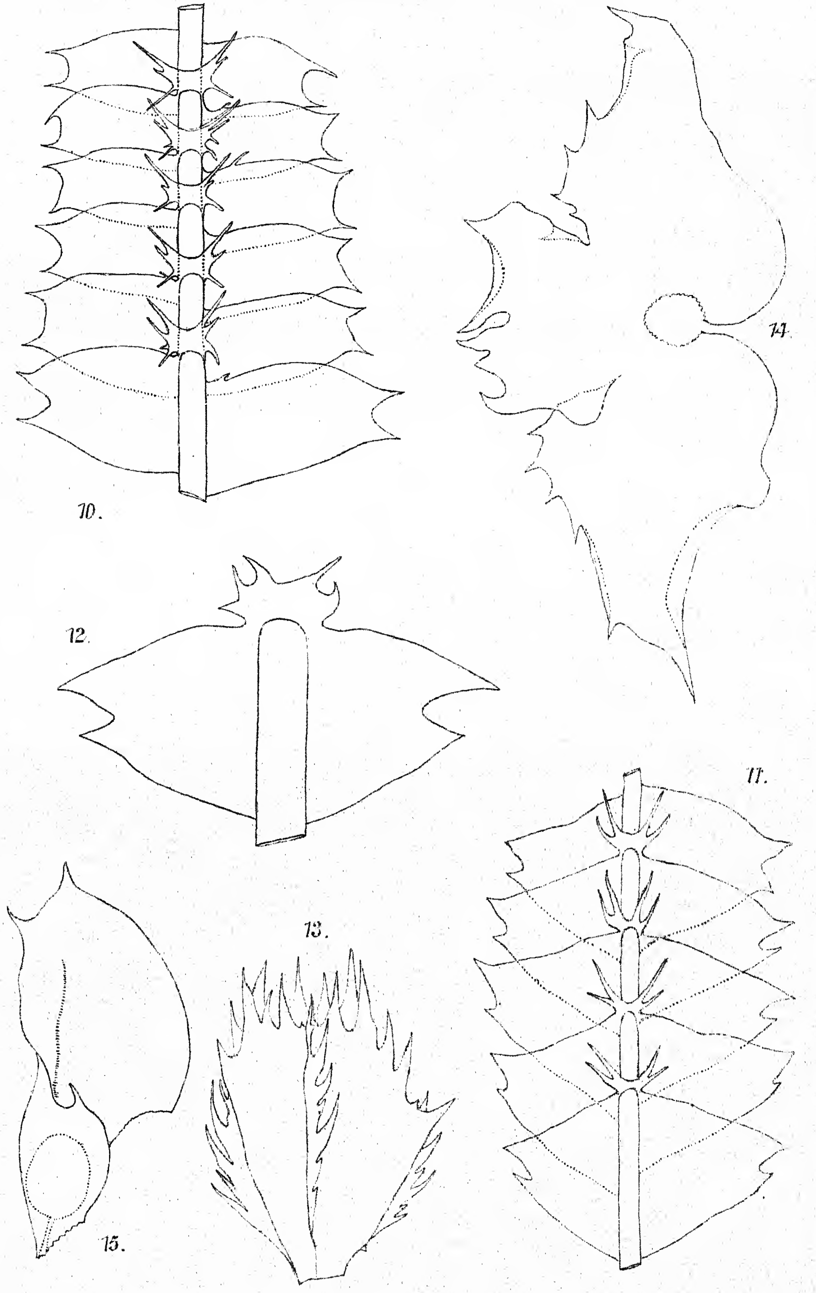
Fig. 18. Part of plant. ×32.
19. Perianth. ×40.
20. Transverse section of perianth. ×40.
21. Male spike. ×40.



F. Stephani del.
F. H. Michael lith.

Mintern Bros. imp.

NEW ZEALAND HEPATICÆ.



F. Stephani del.
F. H. Michael lith.

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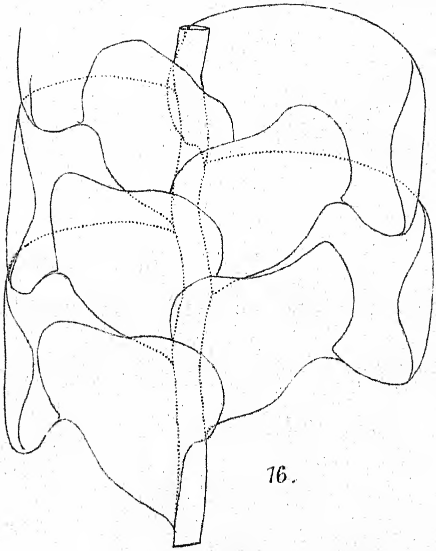

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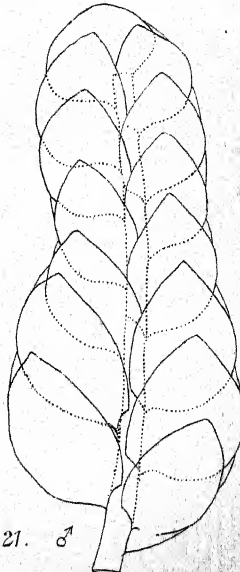
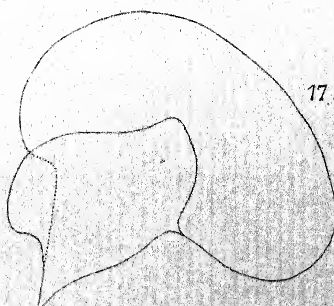


21. ♂



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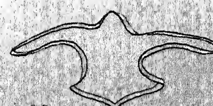

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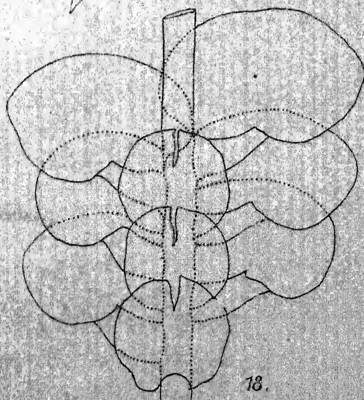

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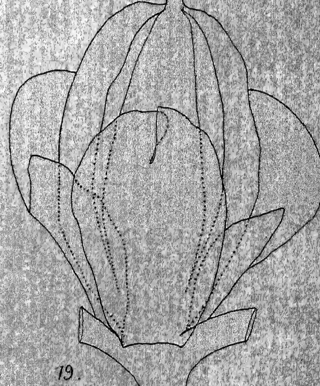


19.

F. Stephani del.
F. H. Michael lith.

Mintern Bros. imp.

NEW ZEALAND HEPATICÆ

On the Pheuomena concerned in the Production of Forked and Branched Palms. By DANIEL MORRIS, M.A., F.L.S., Assistant Director, Royal Gardens, Kew.

[Read 7th April, 1892.]

IN most palms there is a subcylindrical stem surmounted by a mass of palmate, pinnate, or rarely pinnatisect leaves. The stem may vary from a slender reed to a huge column. As it is formed by the continuous development of a single monopodial bud, palms have, normally, an unbranched caudex, either erect, scandent, or sometimes prostrate. For the purpose of anatomical description, Mohl divided palm-stems into certain well-defined classes. These, with slight modifications rendered necessary in the treatment of the present subject, are as follows:—

(*a*) Reed-like—slender, erect stems, as in *Geonoma*, *Chamædorea*, *Rhapis*.

(*b*) Calamoid—long, slender, elastic stems, as in *Calamus*, *Plectocomia*, *Dæmonorops*.

(*c*) Cylindrical—smooth, round, erect, somewhat slender stems, as in *Mauritia*, *Œnocarpus*, *Astrocaryum*.

(*d*) Cocos-like—thick, irregularly marked, sometimes shaggy, tall stems, as in *Borassus*, *Corypha*, *Elæis*, *Cocos*.

To these may be added the so-called stemless palms with short tumid stems, as in *Phœnix acaulis*, *Astrocaryum acaule*, *Sabal Adansoni*.

In *Serenoa serrulata* and *Nipa fruticans* their horizontal creeping stems are said to be slightly branched*. Besides these, the only palms with erect stems that habitually branch are one or two species of *Hyphæne*. The Doum palm, *Hyphæne thebaica*, has several branches arranged dichotomously. *H. Petersiana*, represented in a photograph from Sir John Kirk in the Kew Museum, has very numerous branches, probably 30 to 40 arising from a single stem. *H. coriacea* in the neighbourhood of the mouth of the Zambesi, at least, is seldom more than once-divided; while in the East-African form of *H. crinita* the stem is cylindrical and unbranched. *H. ventricosa*, as its name implies, has a stem swollen in the middle and is also unbranched †. The branching

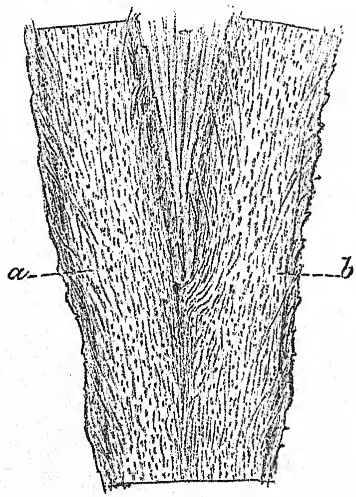
* These, however, are analogous to the underground rhizomes of other palms.

† Kirk in Journ. Linn. Soc. ix. p. 234.

in *Hyphæne*, when it takes place, is said to be due, not to the division of the apical region (which would be true dichotomy), but to the occasional growth of " a single axillary bud, the development of which soon equals that of the parent axis, and causes the deflection of the latter so as to give a forked appearance" *. I am unable to verify this statement by reference to actual specimens; but by analogy it may be assumed to be correct. A similar appearance of dichotomy is shown in the forked specimens of *Pandanus*, *Yucca*, *Vellosia*, *Agave*, *Aloë*, and other monocotyledonous genera. Sachs, in discussing the general mode of branching in monocotyledons, says it " is always monopodial and usually axillary; a bud is generally formed in the axil of each leaf, but often does not unfold; so that the number of branches visible is often less than that of the leaves (as in *Agave*, *Aloë*, *Dracæna*, Palms, &c.) " †.

Asa Gray says, " dichotomy or a forking division of an apex into two . . . . occurs rarely and exceptionally, if at all, in phænogams "‡.

Fig. 1.



Longitudinal section of a branching stem of the Doum Palm, *Hyphæne thebaica* (Kew Museum). *a*. Main axis. *b*. Fully developed axillary branch.

* Henfrey, 'Element. Bot.' (1870), p. 37.

† Sachs's 'Textbook of Bot.,' Engl. transl. (1875), p. 543.

‡ 'Struct. Bot.' p. 47.

The branching in *Hyphæne*, and possibly also in most palms of a similar character, may therefore be regarded as due to the development of side-branches arising from axillary buds, and not to a division of the apical bud (fig. 1). Another point of analogy is found in the development of shoots or suckers from axillary buds at the base of *Phœnix dactylifera*, *Chamærops humilis*, and other palms of a soboliferous character. Further, where injury has occurred to the terminal bud, the axillary buds, usually dormant, are incited into growth by the abundance of nourishment which the former would have monopolized. Another mode of branching is produced by the development of numerous adventitious buds just below the apex. The latter will be shown to be common in certain genera. The particular way in which axillary and adventitious buds appear, and the character they give the plant when lengthened out into branches, differ in almost every genus. The branching in *Borassus* (dichotomous or whorled) is quite unlike that in *Cocos* (often simple forked), while again in *Areca* (erect, branched, or candelabral) it assumes a character easily distinguished from the other genera. Such differences depend upon the length of the internodes, the distribution of the vascular bundles, and probably also the size of the stem.

Branching in palms has not been fully investigated, and the available literature is often scanty and unsatisfactory. For instance, such a record as "a Palm near Keneh (Egypt) has fifteen stems from one root" *, is so vague as to be useless. This may have been a branched date-palm, or a group of stems produced from the root-suckers of the same palm. On the other hand, it may have been nothing but an ordinary specimen of the Doum palm. Again, Mr. William Milne, in a note on the Palms of Fiji †, speaks of "several forking varieties of palms as occurring in those islands." There is here no clue as to the species nor any particulars as to the appearance presented by the trees.

* Gadsby's 'Wanderings' (1880), p. 338.

† Trans. Bot. Soc. Edinb. vi. p. 358.

[*Note added.*—In the Kew Museum is a specimen labelled "fruit of the branched cocoa-nut of the Fiji Islands.—Mr. Milne." It is possible, therefore, that one at least of the forking specimens seen by Mr. Milne was a cocoa-nut palm.]

Martius * figures, in his great work, branched palms of two species only; Masters, in 'Vegetable Teratology' (1869), had so few facts available at the time, that the subject is hardly mentioned. It is probable, also, that the occurrence was looked upon as chiefly the result of morbid growth due to disease or injury. It is, moreover, a peculiarity of branched palms, from the larger area presented by them to strong winds, that they are especially liable to be destroyed by hurricanes. They are probably in many instances comparatively short-lived, and their occurrence may thus escape observation. Many specimens recorded in this paper have already ceased to exist.

A short paper on Branched Palms in Southern India, by Dr. Andy, was read before this Society in 1867 †. The species mentioned were *Borassus flabelliformis* and *Cocos nucifera*. Attention was drawn in the same paper to a leafy proliferation appearing on the spadix of the latter. A paper with exactly the same title was read before the Society a little later by Dr. Shortt ‡. Occasional exhibitions of photographs and drawings of branched palms are recorded in the Society's 'Proceedings.' More recently an interesting "Note on some Branching Palms" was read before the Bombay Natural History Society by Mrs. W. E. Hart in 1888 §. This was illustrated by a figure of the well-known branched palm (*Phœnix sylvestris*) at Indore, and of a specimen of the same species growing on Cumballa Hill, Bombay. References are given to other specimens in India. These communications, with an occasional notice in the 'Gardeners' Chronicle,' appear to exhaust the attempts made to deal with the subject. All are, however, confined to Indian specimens. The species directly and indirectly discussed are of the following genera:—*Borassus, Cocos, Phœnix, Areca*. The further material available consists of scattered references in works of travel, in periodical literature, and in museum hand-books. I am indebted to Mr. B. Daydon Jackson, Secretary of the Society, for many references to works not easily accessible, and I would tender to him my thanks for them.

* 'Hist. Nat. Palm.' i. tab. Z. 2.

† Trans. Linn. Soc. xxvi. p. 661, pl. li.

‡ Journ. Linn. Soc. (Bot.) xi. p. 14.

§ Journ. Bombay Nat. Hist. Soc. iii. p. 250.

It may be well to point out that only those palms are treated as branched that have divisions of the main stem, started at some time or the other from or near the apex. The large number of soboliferous palms that send out axillary buds near the base, such as species of *Phœnix*, *Caryota*, *Diplothemium*, *Chamædorea*, *Chrysalidocarpus*, *Chamærops*, are necessarily excluded. In some of these the axillary buds are developed underground (*rami hypogæi*), forming rhizomes giving rise to clusters of stems crowded together, as in species of *Rhapis*, *Calamus*, *Bactris*, *Geonoma*. Again, owing to the development or two or more ovules in *Cocos* and others (or the occurrence of polyembryony, which is sometimes reported to take place in palms), more than one stem may be produced from one fruit. Such stems appear to start from a single point close to the ground. They are, however, perfectly distinct individuals, although they are sometimes loosely described as possessing several stems arising from one root. They are in no sense branched.

An interesting group of palms, belonging to several widely distinct genera, described as monocarpic has a terminal inflorescence appearing once only. After the plant has flowered and ripened its fruit, it dies*. Some soboliferous palms, such as *Metroxylon*, are also monocarpic. Other monocarpic genera are: *Corypha*, *Raphia*, *Caryota*, *Ancistrophyllum*, *Plectocomia*, *Eugeissonia*, and possibly *Arenga*. I am unable to record a single instance where a branched stem appears amongst monocarpic palms. The probable reason for this is owing to the fact that the life and vigour of these plants are so fully localized in the terminal bud, that when this is destroyed there is not sufficient energy left to push forth new buds. It would be useful to keep such palms under observation with the view of solving this problem.

The genera in which branched palms have so far been observed are as follows:—

* Asa Gray (Struct. Bot. p. 33) suggests monotocous (bearing progeny once) and polytocous (bearing many times) instead of De Candolle's terms monocarpic and polycarpic.

Natural Order PALMÆ.

Tribe.	Genus.
Areceæ	Areca.
	Rhopalostylis.
	Dictyosperma.
	Oreodoxa.
	Leopoldinia.
Phœniceæ	Phœnix.
Corypheæ	Nannorhops.
Borasseæ	Hyphæne.
	Borassus.
Cocoineæ	Cocos.

Tribe ARECEÆ.

ARECA CATECHU, *L.* Betel-nut Palm.

A very slender, tall palm, widely cultivated in the Eastern tropics. The occurrence of forked or branched specimens is evidently very rare. Dr. Andy reports the existence of a specimen with dichotomous division, existing prior to 1867, in the town of Trevandrum, Southern India *. An apparently similar specimen is quoted from the 'Times of India' (1888) by Mrs. W. E. Hart as occurring at Cayenne †. This was 100 feet high, and divided at a height of about 30 feet into two stems equal in height and diameter. A third specimen, 10 years old and about 20 feet high, was noticed by Mr. W. F. Sinclair at Shriwardhan, Tanjore, in December 1889 ‡. "About three years previously it was attacked by a disease called *Bánd* §, which had killed many trees in the neighbourhood, when the top almost died away. This has now been replaced by 15 to 18 distinct tops growing in a flat close bundle in such a manner that one cannot count them accurately without climbing the tree. The whole tree has the appearance of a gigantic housemaid's broom." This account is of value as showing the appearance of a palm during the early stages of branching. Mr. Sinclair's observation as regards branching

* Trans. Linn. Soc. xxvi. p. 662.

† Journ. Bombay Nat. Hist. Soc. iii. p. 252.

‡ Ibid. iv. p. 317.

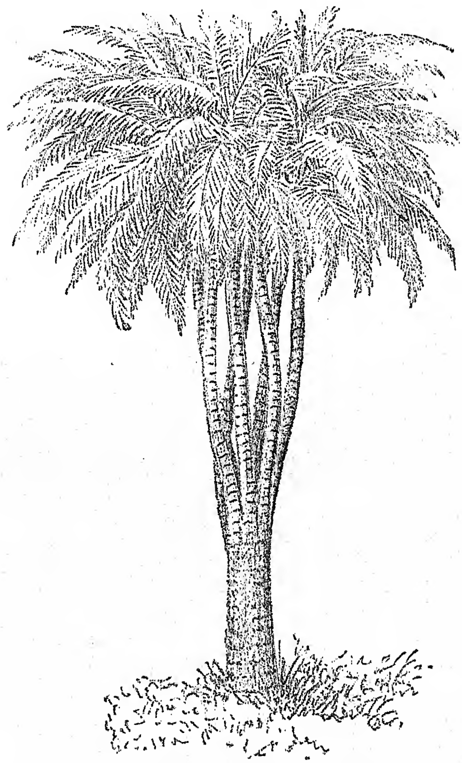
§ "Bánd" or "Bound." Probably a local disease induced by unfavourable conditions of soil or climate.

immediately following injury to the terminal bud is supported by numerous instances recorded in other palms.

RHOPALOSTYLIS SAPIDA, *H. Wendl. & Drude.* Nikau Palm.

This, one of the most southerly known palms, is a native of New Zealand. It has a slender, straight stem with pinnate leaves. An interesting specimen with eleven branches is described and figured by Mr. Percy Smith, who found it growing at the base of

Fig. 2.



Branching specimen of Nikau Palm, *Rhopalostylis sapida* (Percy Smith).

Tangihua Mount, Whangarei, New Zealand (fig. 2). At 5 feet from the ground it divided into eleven distinct branches, and after rising some 10 feet higher some of the latter divided again into

other branches. The total height was 30 feet; each branch was covered with a fine head of luxuriant leaves *.

DICTYOSPERMA ALBUM, *H. Wendl. & Drude.* (Areca alba, *Bory.*)

Martius (Hist. Nat. Palm. i. tab. Z. 2) figures five specimens of this palm with from two to seven branches. They are very similar in habit to those described in the last species. Dr. King, of the Royal Botanical Gardens, Calcutta, mentions the occurrence of a forked specimen of this species in his collections in 1886 †.

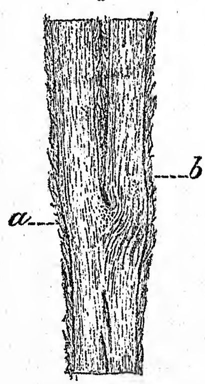
OREODOXA REGIA, *Kunth.* Royal Palm.

Oreodoxa regia and *O. oleracea* are known as the cabbage-palms of Tropical America. The former is very ornamental, and is often used to form magnificent avenues, as in the Botanical Gardens of Rio de Janeiro. A singularly branched specimen with nine heads is mentioned by Ramon de la Sagra as occurring at Baracoa, Cuba ‡. The axis was single up to a certain height. It then appeared to spread horizontally to the right and left, and ultimately give rise to nine branches of a candelabral character, all apparently in the same plane.

LEOPOLDINIA PULCHRA, *Mart.* Jará Palm.

This handsome palm has stems 6 to 8 feet in height. They

Fig. 3.



Section of branched specimen of *Leopoldinia pulchra* (Kew Museum). *a.* Main axis. *b.* Axillary branch.

* Trans. N. Z. Instit. x. (1878), p. 175.

† Proc. Agri-Hort. Soc. Ind. viii. p. xlviii. ‡ Comptes Rendus, lxx. p. 550.

are either solitary or cæspitose. They appear sometimes in dense clusters, arising from root-suckers around the parent stem, or from underground shoots. A stem of this palm, brought by Dr. Trail from near Manaõs on the Rio Negro, Brazil (in the Kew Museum), is forked. This was probably caused by the growth of an axillary bud, as in *Hyphæne thebaica* (fig. 3).

Tribe PHŒNICEÆ.

PHŒNIX DACTYLIFERA, *L.* Date-Palm.

The date-palm is a native of North Africa and South-western Asia. It thrives in the driest regions. This is one of the few species habitually throwing out shoots at the base also said to be branched. Martius (Hist. Nat. Palm. i. tab. Z. 2) figures a specimen of *P. dactylifera* with a short side-branch midway between the base and summit. The size and position of this branch are not, however, conclusive in favour of admitting the date-palm amongst those with recognized branches. The only other evidence is given by Brandis (‘Forest Flora,’ p. 553), who states that “branching stems are occasionally found in the Punjab.” Brandis is so reliable an authority, that the statement has weight. On the other hand, the “date-palm” of the North-Western Provinces and the Punjab is *Phœnix sylvestris*. Mr. Grote, F.L.S., exhibited before the Society (Proceedings, 1872–73, p. vi) a drawing of a branched *P. dactylifera*, but no particulars are given.

Stewart *, referring to the records of branching in palms in Northern India, states, “I quite agree with Edgeworth that they merely result from seeds falling into and germinating in the axils of the petioles.” Brandis rightly regards this view “as improbable.” The same point has been fully discussed and shown to be quite untenable by Dr. Beaumont †.

PHŒNIX SYLVESTRIS, *Roxb.* Khajoor or Wild Date.

This forms extensive forests in some parts of India. It yields a sweet juice (toddy) which is largely made into sugar (jaggery). A deep notch is made into the trunk near the apex. The juice

* ‘Punjab Plants,’ p. 224.

† Cited in ‘Gardeners’ Chronicle,’ i. (1874), pp. 116–118.

flows for some time, and after a short rest a similar notch is cut on the other side. A wild date is fit to cut when six to ten years old, and yields toddy for twenty years.

There are many instances of branching specimens amongst the wild date of India. A fine specimen was growing in the Residency Garden, Indore, in 1873, with a trunk 22 feet high to the first branch, and with twenty vertical closely packed branches. In 1888 these branches were reduced to twelve. A figure was given in the 'Journal Agri-Hort. Soc. India,' iv. n. s. 1873, and a more recent one in the 'Journal Bombay Nat. Hist. Soc.' vol. iii. (1888) p. 250. Mr. J. Scott, in communicating a note on the above palm to the Agri-Hort. Society of India, mentioned that a large specimen of the wild date existed near Ooloobariah with seven well-developed heads. Another, but a smaller one, existed at Sookchur, near Barrackpore, with six lateral branches overtopped by the main crown. Both these were uprooted by the cyclone of 1864. Mr. Storey forwarded a photograph of a branched wild date growing in a jungle about thirty miles from Oodeypore *. This had a low stem branching at a few feet from the ground with seven branches, one being broken. Mr. Storey attributes the branching of palms in his neighbourhood to the action of a palm-beetle, identified by Professor Westwood as *Oryctes rhinoceros* †. He adds, "I have in my garden one tree which has been attacked, and it is now throwing out a side-shoot." A third specimen, shown in a photograph also sent by Mr. Storey (now in the Kew Museum), is a striking tree with three branches. One of these appears to be a side-shoot which has emerged at a comparatively late period. A specimen shown in a photograph taken by Mr. C. B. Clarke, F.R.S., at Nowgong, Assam (in the Kew Museum), has several branches arranged alternately along the stem. The first emerged at about 4 feet from the ground. In this, as in *Nannorhops Ritchieana* (presently to be considered), these branches appeared to be produced by flowering buds being replaced by branch-buds.

NANNORHOPS RITCHIEANA, *H. Wendl. & Drude.*

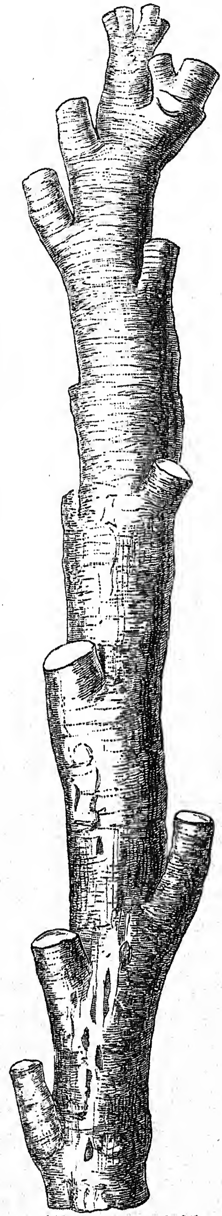
This is a fan-leaved palm, a native of the barren hills below

* Gard. Chron. ii, (1889), p. 275, fig. 40.

† *Oryctes rhinoceros* is commonly known as the Rhinoceros, Elephant, or Black Beetle. Another enemy of palm-trees is *Rhynchophorus ferrugineus*, known as the Red Beetle. Two species of other beetles (*Calliandra*) also injure palms.

the tableland of Afghanistan and Beloochistan, and extending into Kashmir. It is generally stemless, the tufts of leaves arising from a creeping underground rhizome. A stem is, however, produced under favourable circumstances. Dr. Aitchison states *:—"At Alizai I succeeded in procuring for the Museum at Kew a branching specimen of *N. Ritchieana*. . . . The production of branches in this palm is due, I believe, to the arrest of the large inflorescence." The specimen brought by Dr. Aitchison is about 10 feet high, and there are fifteen branches alternately arranged on the trunk (fig. 4). According to a further note by Dr. Aitchison †, this palm was "frequently seen occurring in sheltered places as a branching tree of from 15 to 25 feet in height."

Fig. 4.



Branching stem of *Nannorhops Ritchieana* (Kew Museum).

BORASSUS FLABELLIFORMIS, *L.* Palmyra Palm.

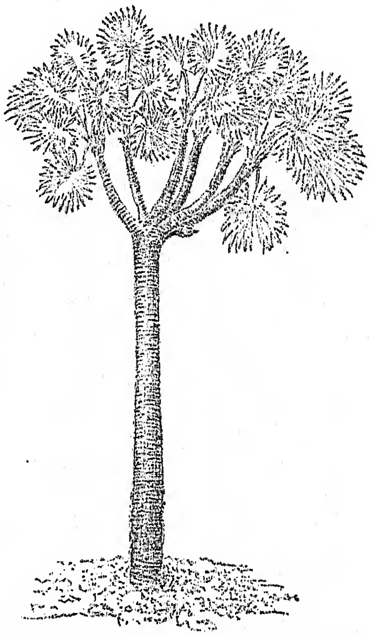
A large fan-leaved palm of the East Indies and Tropical Africa. It has a stout stem 60 to 100 feet high. It is a toddy-yielding palm, and large quantities of jaggery sugar are obtained from it. This species is not infrequently found in a branched state. It is described (Gen. Plant. iii. p. 939), "interdum apicem versus furcato v. pauci-ramoso." It is a marked feature in the branching of the Palmyra palm that the number of branches is very numerous, often so high as forty and seldom below four. The stems are either forked as in *Hyphæne*, or they sometimes emerge in a whorl almost at right angles to the main trunk. Both sorts are shown in Dr. Andy's paper already cited ‡.

* Journ. Linn. Soc. (Bot.) xix. p. 140 (with figure).
† Gard. Chron. ser. III. ii. (1886), p. 652.
‡ Trans. Linn. Soc. xxvi. p. 661, pl. li.

The following instances of branching in *Borassus flabelliformis* are recorded:—

Jaffna, Ceylon (*W. Ferguson*), 'Palmyra Palm,' p. 40, with coloured plate, [6]* (fig. 5). Other branched specimens are

Fig. 5.



Branched Palmyra Palm, *Borassus flabelliformis*, Ceylon (W. Ferguson).

cited in this work as occurring "on the island of Delft and on the smaller islands near Jaffna, and the writer saw one some months ago (1850) near Oodooville with six heads." Amedahad, India (*Forbes*), 'Oriental Memoirs,' ii. p. 201, [40]. Travancore (*Andy*), Trans. Linn. Soc. xxvi. p. 661, pl. li. fig. 1 [4], fig. 2 [7]. Madara, India (*Shortt*), Journ. Linn. Soc. (Bot.) xi. p. 14 (with woodcut), [9]. Other specimens cited in this note are as follows:—Masulipatam [12]; Paulghaut [6]; Ramnad [4], "below the divisions the stem is covered with numerous other shoots of

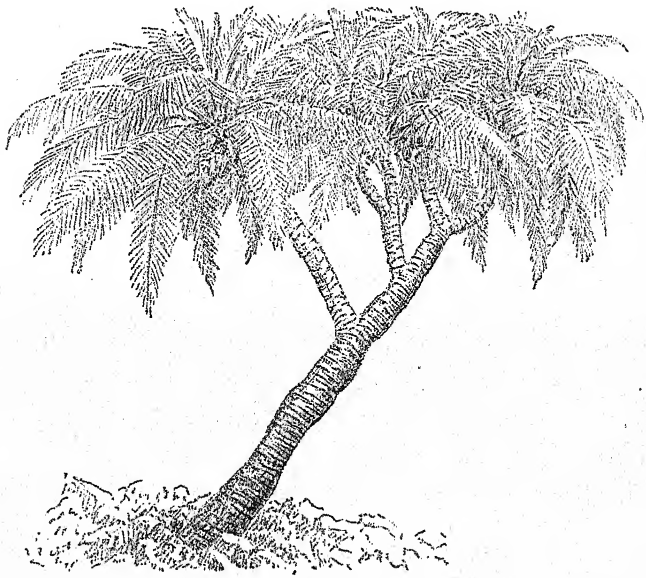
* The figures in square brackets in this and following sections indicate the numbers of branches present in each instance.

different sizes." Tanjore (*Bidie*), Proc. Linn. Soc. 1887–88, p. 3, [8]. India (*Burton*), 'An Indian Olio,' p. 79, cited in Journ. Bombay Nat. Hist. Soc. iii. p. 253, [7]. Brandis, 'Forest Flora,' p. 545, states, "forked and branched stems are occasionally seen." East Africa (*H. H. Johnston*), 'Kilima-njaro Expedition,' p. 349, fig. 65, [3].

Cocos nucifera, *L.* Cocoanut Palm.

The cocoanut is possibly the most widely distributed of any palm. It is found under cultivation in the tropics of both worlds. It is therefore under close observation, and the occurrence of

Fig. 6.

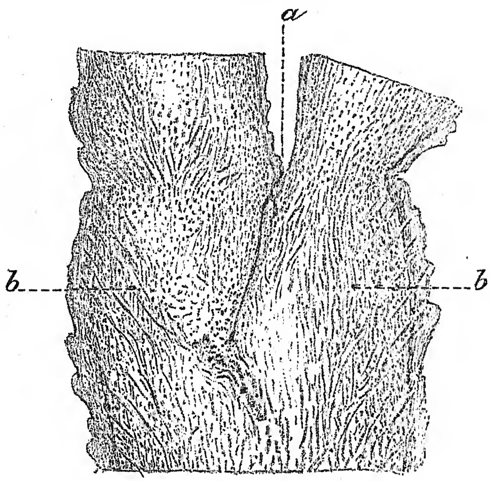


Branched Cocoanut Palm, *Cocos nucifera*, Dornock Pen, Jamaica (De B. Heaven).

branched specimens is readily noticed. In spite of this, however, Sir John Kirk in twenty years saw only one specimen of a branched cocoanut palm in East Africa, although during that time he had observed several hundred thousands in a normal state. In nine out of thirteen cases here recorded the stem is once-forked only.

In the others a regular dichotomous branching may be traced. The highest number of branches recorded is seven. At Calcutta a branched cocoanut, since blown down, was held in great veneration and offerings of flowers, fruit, and rice were scattered around its roots by the Hindoos. In Fiji a forked stem of a

Fig. 7.



Longitudinal section through stem of branched Cocoanut Palm, *Cocos nucifera*, Fiji (Kew Museum). *a*. Position of destroyed terminal bud. *b*, *b*. Axillary branches.

cocoanut palm (now in the Kew Museum) was called "*Nim nibsanga* by the natives, who attached superstitious ideas to the occurrence." The following instances of branched cocoanut palms have been noticed:—

Seychelles (North Gallery, No. 491), [6]; Dornock Pen, Jamaica (*Heaven*), drawing, [5]: Proc. Bot. Soc. Edin. vi. p. 75 (see fig. 6); Chapelton, Jamaica (*Schardsmidt*), drawing, [2]; Fiji, specimen Kew Mus. ii., [2] (see fig. 7); Singapore (*Jamie*), photograph, Kew Mus. ii., [2]; Zanzibar (*Kirk*), photograph, Kew Mus. ii., [2]; Travancore (*Andy*), Trans. Linn. Soc. xxvi. p. 661, pl. li., [2]; Mount Lavinia, Ceylon (*Haldane*), drawing, [2]; Kuripan, Java (*Otto Kuntze*), 'Um die Erde,' p. 288, [2]; Jabalpur (*Kabraji*), cited in Journ. Bombay Nat. Hist. Soc. iii. p. 250, [7]; Calcutta (*Scott*), Gard. Chron. i. (1874) pp. 116–118,

[5]; Coneghur (*Scott*), ibid. [2]; Grote in Proceedings Linn. Soc. 1872–73, p. vi, "Drawing of branched cocoanut palm."

In the Areceæ the branches vary in number from two to eighteen. Where the stem is simply forked, the branches have arisen as will be shown presently in *Cocos nucifera*. The branches often are erect, numerous, and closely packed. The destruction of the terminal bud is particularly observed in one instance, *Areca Catechu*; and the result is a mass of adventitious buds crowded near the apex. In *Oreodoxa regia* the candelabral appearance of the branches in the specimen found at Baracoa, Cuba, is very remarkable, as it exhibits an extreme development of morbid growth. In most of the other specimens the branches are healthy and well grown; and in the New-Zealand *Rhopalostylis*, especially, there is now, at least, no trace of either disease or injury. The occurrence of branched specimens in the genus *Leopoldinia* is apparently new.

Amongst the Phœniceæ the date-palm, *Phœnix dactylifera*, is recorded in a branched state only with a small side-branch on the main stem. The only accessible figure is that given by Martius, and this exhibits a side-branch midway between the base and summit. Numerous shoots are, however, thrown out in this species near the base. Similar shoots in a specimen at Bombay are thrown out at 3 feet from the base. It is possible a shoot similar to that shown by Martius (when the terminal head of leaves is intact) may be only an extreme instance of the occurrence of basal shoots; or it may have been produced when the terminal bud was temporarily checked but not destroyed. There is, however, a third alternative, viz. that it is an instance of the displacement of a flowering-shoot by a branch-shoot. The material for arriving at a satisfactory conclusion in regard to this species is incomplete.

The numerous instances recorded of branching in *Phœnix sylvestris*, supported by good drawings and photographs, offer a much better field for investigation. There are two very clearly traced causes for branching in this palm. The more general cause is probably injury to the terminal bud during the process of tapping for toddy. In a large number of cases the branched specimens show marks of having been tapped. It is possible that where this is severe, it has led to the destruction of the tree; in others with a greater vitality it has only caused the loss

of the crown with the subsequent growth of axillary or adventitious buds. In some instances branched specimens have been produced (as in the instance recorded by Mr. Storey at Oodeypore) by the attack of insects. The branches are often numerous (three to twenty-two) and erect. The occurrence of "six lateral branches overtopped by the main stem" (briefly recorded but not figured by Scott) at Sookchur may have been produced, (1) by the displacement of flowering buds by branched buds (cf. *Nannorhops*); or (2) the development of adventitious buds when the terminal bud had been temporarily checked but not destroyed. The first of these alternatives is probably the true interpretation of the occurrence in the wild date of Assam photographed by Mr. C. B. Clarke.

Amongst the *Corypheæ* (which include both monocarpic and polycarpic palms), *Nannorhops* is apparently the only genus in which branched specimens appear. On exposed hills *Nannorhops Ritchieana* is stunted and stemless; in valleys in good soil it produces stems 5 to 7 feet in height or more. The branching in the frequent specimens observed by Dr. Aitchison in the Kurrum Valley * (if identical with the specimen in the Kew Museum) is very interesting. Here the branches are arranged alternately along the stem from base to summit, occupying the usual position of the flowering-shoots. Dr. Aitchison's explanation that these branches are due to a replacement of flowering-buds by branch-buds is probably correct. As these branches appear only on specimens in sheltered places with good soil—circumstances usually regarded as favourable to the production of leafy and branch-shoots instead of flowering-shoots—this view is confirmed. This is a well-established instance where a palm branches regularly without injury to the terminal bud. In this it agrees with what is recorded with regard to branching in some specimens of *Phœnix sylvestris*.

In the *Borasseæ* are included two or more species of *Hyphæne* with habitually branched stems. In *Borassus flabelliformis* branched stems are frequently produced. The branching in *Borassus* is caused in some cases by injury to the terminal bud by tapping for toddy; in a few it may be due to insect injury. It is, however, in some cases so regular and free from morbid growth, that it is exactly comparable to what takes place in the

* Journ. Linn. Soc. (Bot.) xix. p. 141; Gard. Chron. ser. III. ii. (1886), p. 652.

branching of *Dracæna Draco* *. Numerous axillary buds have arisen in a whorl at the apex of the stem, and when prolonged into branches they form a dense mass radiating in all directions. On the other hand (as shown in Ferguson's coloured plate, reproduced in fig. 5), there are some specimens exhibiting the extreme condition of morbid growth seen in *Oredoxa regia* at Cuba, with a candelabral branching system in one plane.

In *Cocoineæ* the only branched specimens so far recorded belong to the single species *Cocos nucifera*. In the other genera of this tribe, for instance *Elæis*, are included palms occupying the area of nearly half a continent, and yet not a single instance of branching appears to be recorded amongst them. The characteristic feature in branched cocoanut palms is the simple fork, *i. e.* a single pair of branches surmounting the original stem. The cause of this simple forking may arise as shown in *Hyphæne*, or be consequent upon injury to the terminal bud. In the latter case the terminal bud is destroyed by insects or by some mechanical injury. Two axillary buds inserted immediately below (one on either side) would grow out into branches. This is comparable to what takes place in the common lilac, where the terminal bud is aborted and the two uppermost axillary buds take its place. The forked appearance common in *Cocos nucifera* may therefore have its origin in a cause entirely different from that seen in *Hyphæne*. An instance of the displacement of flowering-buds by branch-buds in *Cocos nucifera* has not yet been traced. The leafy proliferation of the spadix of this palm, in Southern India, noticed by Dr. Andy is, however, of interest.

From a consideration of the foregoing it may be gathered:—(*a*) Branching is habitual in certain species of *Hyphæne*; it is occasional in certain other species of *Hyphæne*, and (arising from various causes) it is occasional also in certain palms belonging to the genera *Areca*, *Rhopalostylis*, *Dictyosperma*, *Oreodoxa*, *Leopoldinia*, *Phœnix*, *Nannorhops*, *Borassus*, and *Cocos*. (*b*) In numerous cases branching in palms is the result of injury to, or destruction of, the terminal bud causing the development of axillary or adventitious buds below the apex. These buds, when lengthened-out, produce branches. (*c*) In some cases branching in palms, as in *Nannorhops Ritchieana* and *Phœnix sylvestris*, is caused by the replacement of flowering-buds by branch-buds. In

* *Dracæna Draco* in Supp. Gard. Chron., Oct. 20, 1888, and *Borassus flabelliformis* in Trans. Linn. Soc. xxvi. p. 661, pl. li. fig. 1, may be thus compared.

such cases the branches are usually short, and are arranged alternately along the stem. The terminal bud is apparently neither injured nor destroyed. (*d*) Palms that are usually soboliferous (producing suckers at the base) are rarely branched at or near the apex. And, lastly, (*e*) no instance appears to be so far recorded of a monocarpic palm with a branched stem.

[*Note added.*—In a "Narrative of an Expedition across Melville Island, north of Port Darwin, Australia" (Trans. Roy. Soc. South Australia, vol. xv. p. 117), Mr. Maurice Holtze writes:—"A botanical novelty which I would have liked very much to have taken with me was found in the shape of a *Livistonia humilis* with four distinct branches." This record is interesting as adding another genus to those already mentioned in which branched palms have been observed. This is apparently the only instance recorded of a branched palm in Australia.—D. M.]

Observations on a Botanical Collection made by Mr. A. E. Pratt in Western China, with Descriptions of some new Chinese Plants from various Collections. By W. Botting Hemsley, F.R.S., A.L.S.

[Read 21st April, 1892.]

(Plates XXIX.–XXXIII.)

When the publication of an enumeration of all the plants known from China was commenced in this Society's Journal (vol. xxiii.) in 1886, we knew almost nothing (in this country, at least) of the botany of the Central and Western Provinces. It is true that Mr. Franchet had already published the first part of his 'Plantæ Davidianæ'; but that contained a comparatively small number of novelties and among them no new genera. Since then, owing to the stimulus given by the publication of the "Enumeration," very large collections have been made by Dr. A. Henry and others, chiefly in the provinces of Hupeh and Szechuen, and transmitted to Kew. The Reverend E. Faber ascended Mount Omei, an isolated elevation on the Min river, upwards of 11,000 feet high, and botanized it, the result being a large number of novelties, including about fifteen ferns. Several other gentlemen, chiefly missionaries and members of the consular service, have sent smaller collections of dried plants to Kew. But it is not my intention to enter into

particulars respecting these collections, though it seemed desirable to allude to them, because I shall have occasion to mention them in some comparisons with Mr. Pratt's collection.

In 1889 and 1890 Mr. Pratt travelled in Western China close on the borders of Eastern Tibet, mainly for the purpose of collecting Zoological specimens. Fortunately, however, he was induced by Dr. Henry to engage a native (whom Dr. Henry had trained to dry plants) to assist him in making a botanical collection.

It is of this collection I would say a few words, as a sort of preface to the descriptions of the novelties. The collection was made chiefly in the neighbourhood of Tachienlu, at elevations of 9000 to 13,500 feet. Tachienlu is a town near the frontier, situated in about 30° N. lat. and 102° 15′ E. long., at an elevation of 8350 feet. Full particulars of this region are given in Mr. Colborne Baber's interesting narrative of his exploration of the region, in the first volume of the Supplemental Papers of the Royal Geographical Society, and in Mr. Pratt's account of his own journeys in the thirteenth volume of the Proceedings of the same Society.

I have not yet finished working out Mr. Pratt's collection, but I estimate that it contains at least 500 species, mostly represented by numerous admirably selected specimens, as may be judged from the small selection I am able, through the kindness of the Director of Kew, to exhibit here this evening. The flora of the mountains of Western China abounds in showy herbaceous plants, equalling, if not surpassing, the richest districts of the Himalayan region, of which indeed it is a continuation. As in the Eastern Himalayas, every valley has its peculiar species. Roughly speaking, I should say that the collection contains about 150 new species, of which, however, at least a third were also collected by Prince Henry of Orleans, who arrived with Mr. Bonvalot at Tachienlu during Mr. Pratt's stay there. These were published last year by Professor Bureau and Mr. Franchet in the 'Journal de Botanique'; and through the kindness of these gentlemen and the personal assistance of the latter, I have been able to compare the novelties of the two collections. This was a great advantage, because the Prince collected no duplicates. With all this wealth of new species there is not a single new genus, whereas Dr. Henry and Mr. Faber between them discovered about twenty-five new

genera, but they collected at lower elevations. It is a noteworthy fact, that above certain elevations and beyond certain latitudes, varying in different parts of the zone, the generic composition of the northern flora is very uniform throughout. In other words, the peculiar genera of the several regions are found at lower elevations and in lower latitudes; and at great elevations, even in low latitudes, local genera are almost unknown. Among the genera represented by several or many species are:—*Clematis*, *Anemone*, *Cardamine*, *Corydalis*, *Hypericum*, *Rubus*, *Potentilla*, *Rosa*, *Saxifraga*, *Ribes*, *Sedum*, *Lonicera*, *Senecio*, *Saussurea*, *Primula*, *Lysimachia*, *Rhododendron*, *Gentiana*, *Pedicularis*, and *Cypripedium*.

In addition to new species of essentially Himalayan genera there are many Himalayan species, as:—*Clematis montana*, *Anemone rivularis*, *Caltha scaposa*, *Decaisnea insignis*, *Corydalis ophiocarpa*, *Stachyurus himalaicus*, *Hedysarum sikkimense*, *Maddenia himalaica*, *Cyananthus incanus*, *Cypripedium tibeticum*, *Paris polyphylla*, and *Aletris nepalensis*.

Not a few Japanese species extend to the Western provinces of China. Familiar examples are:—*Anemone japonica*, *Euptelea polyandra*, *Corylopsis spicata*, *Primula japonica*, *Habenaria japonica*, and *Smilacina japonica*. Among the ground orchids three are North-American, namely:—*Cypripedium arietinum*, *C. spectabile*, and *Epipactis gigantea*.

It is remarkable that out of about twenty ground orchids only two are local, and most of the others have a wide range, four being British. They include six species of *Cypripedium*.

Nevertheless, as already observed, the proportion of local species in the collection as a whole is large. Associated with them are the following British plants:—*Caltha palustris*, *Actæa spicata*, *Malva sylvestris*, *Hypericum perforatum*, *Oxalis Acetosella*, *Geranium Robertianum*, *Lotus corniculatus*, *Lathyrus pratensis*, *Potentilla fruticosa*, *Agrimonia Eupatoria*, *Pyrus Aucuparia*, *Epilobium angustifolium*, *Circæa alpina*, *Cephalanthera ensifolia*, *Gymnadenia conopsea*, and *Habenaria chlorantha*.

This does not exhaust the number of British plants in the collection, the list being given merely as a sample. Very few ferns were collected, but there is one new *Adiantum* among them.

With regard to the novelties I need say no more; but some idea of the richness of the flora of Central and Western China may be gathered from the following figures. Taking half-a-dozen

herbaceous genera I find that the known Chinese species of *Pedicularis* number about 100, *Gentiana* is represented by 65 species, *Senecio*, *Saussurea*, and *Primula* each by 50, and *Lysimachia* by 40. Taking in the same manner half-a-dozen woody genera, *Rhododendron* has 70 species, *Rubus* 50, *Lonicera* 40, *Viburnum* and *Vitis* 30 each, and *Euonymus* 20.

I may add that a very large proportion of these species have been collected in the provinces of Hupeh, Szechuen, and Yunnan, and further that only certain districts of these provinces have been fully explored.

Many other interesting facts have come to light in this connection, but I must reserve them for a more detailed examination of the flora.

I am indebted to Mr. Rolfe for the descriptions of the Orchids, to Mr. N. E. Brown for those of the Aroids, and to Mr. J. G. Baker for that of the Adiantum.

Descriptions of New Species.

Trollius ranunculoides, *Hemsl.*

Species facie *Ranunculi bulbosi*, sed scapis semper unifloris.

Herba perennis, scaposa, undique glabra, 6–9 poll. alta, scapis nudis unifloris. *Folia* petiolata, orbicularia, vix 1 poll. diametro, palmatim 3–5-lobata, lobis trifidis simul acute denticulatis, petiolo circiter bipollicari. *Flores* 1–1½ poll. diametro, erecti, flavi; sepala sæpius 5, lata, orbiculari-spatulata, venosa; petala sæpius 10, clavata, apice majus incrassata, aurantiaca, staminibus breviora; stamina numerosissima; ovaria circiter 12, et circiter 12-ovulata. *Folliculi* maturi non visi.

Pratt, 560*.

Delphinium (§ Delphinastrum) pachycentrum, *Hemsl.*

Ex affinitate *D. dasyanthi*, sed robustius racemis densioribus calcari longiore obtuso fere cylindrico sepalis obtusis.

Herba perennis, erecta, fere undique puberula, caulibus simplicibus crassis circiter pedalibus. *Folia* radicalia non visa, caulina conferta, omnia distincte graciliterque petiolata, crassiuscula, circumscriptione cordato-rotundata, 1½–3 poll. diametro, sæpius palmatim 5-partita, segmentis subtrifidis simul irregulariter

* As all of Mr. Pratt's plants have the same general label, namely, "Western Szechuen and Tibetan Frontier: chiefly near Tachienlu at 9000 to 13,500 feet," it is unnecessary to cite any more than the number.

pluri-lobulatis, lobulis parvis oblongis obtusiusculis; petiolus 1–2-pollicaris. *Flores* 12–14 lineas longi, cærulei, petalis apice albis, sericeo-pubescentes, dense breviterque racemosi, fere horizontales, pedicellis quam flores demum longioribus, bracteis bracteolisque angustissimis; sepalum posticum longe crasseque calcaratum, calcari leviter curvato, limbo obliquo brevissimo; sepala reliqua paullo longiora, anguste oblonga; petala 4, sepala æquantia, fere glabra, 2 anteriora latiora, graciliter unguiculata, parce pilosula; stamina glabra, filamentis dilatatis arcte conniventibus; ovaria 3, dense pubescentia. *Folliculi* maturi non visi.

Pratt, 462.

This species is near *D. dasyanthum*, Kar. et Kir., differing in robust habit, cutting of the leaves, and floral characters.

Berberis (§ Euberberis) polyantha, *Hemsl.*

Species ex affinitate *B. integrifoliæ* sed foliis plus minusve aculeato-denticulatis floribus fasciculatim racemoso-paniculatis.

Frutex ramis elongatis graciliusculis paucisponsis. *Folia* crassa, coriacea, persistentia? dense fasciculata, breviter petiolata vel subsessilia, obovato-spathulata, 9–18 lineas longa, apice rotundata, deorsum attenuata, margine pauci-aculeolata, supra nitida, subtus pallidiora, venis prominenter reticulatis. *Paniculæ* densæ, 2–4 poll. longæ. *Flores* flavi, inter minores, breviter pedicellati. *Bacca* ignota.

Pratt, 80, 206, 704.

Corydalis cheilanthifolia, *Hemsl.*

C. aduncæ similis sed scaposa foliis majus dissectis floris calcari sursum curvato.

Herba perennis, glabra, radice fibrosa. *Folia* erecta, longe petiolata, membranacea, circumscriptione lanceolata, 4–10 poll. longa, bipinnatisecta, segmentis ultimis usque ad 13 parvis 2–4 lineas longis sæpius 3–5-dentatis interdum integris. *Scapi* erecti, folia æquantes vel superantes, pauciflori, laxiflori, bracteis linearibus acutis integris pedicellos æquantibus. *Flores* parvi, 6–8 lineas longi, angusti, calcari lamina dimidio breviore; sepala e basi lata acuminata, obscure denticulata; petala exteriora vix cucullata, interiora longe unguiculata; antheræ supra stigma cohærentes. *Capsula* elongata, moniliformis, circiter pollicaris sed matura non visa.

Hupeh: South Patung, *Dr. A. Henry*, 3723, 5399.

Cardamine stenoloba, *Hemsl.*

Pergracilis, caulibus flexuosis foliis dimorphis caulinis superioribus distanter alte pinnatisectis segmentis angustissimis.

Herba annua? erecta, circiter semipedalis, undique glabra, caulibus sæpius simplicibus. *Folia* radicalia (pauca tantum visa) pinnata, 5–7-foliolata, gracillime petiolata; foliola orbicularia, vix 2 lineas diametro, breviter petiolulata; folia caulina 5–7-lobata, 1–1½ poll. longa, superiorum segmentis rhachidisque fere subulatis, inferiorum segmentis paullo latioribus. *Flores* pauci, laxe racemosi, circiter 3 lineas diametro; sepala ovalia, albo-marginata, quam petala triplo breviora; petala late spathulata. *Siliqua* matura non visa sed ut videtur gracillima, demum patens vel reflexa.

Szechuen: without locality, *Dr. A. Henry*, 8724; *Pratt*, 352.

Braya sinensis, *Hemsl.* (Plate XXIX.)

Acaulis, radice simplici crassa fusiformi, foliis integris paucidentatis vel pinnatifidis, pedunculis folia æquantibus vel excedentibus.

Herba biennis? 2–3 poll. alta, omnino glabra. *Folia* rosulata, numerosissima, angusta vel angustissima. *Pedunculi* nudi, uniflori. *Flores* 6–8 lineas diametro; sepala basi æqualia, ovalia, obtusissima, quam petala dimidio breviora, margine membranacea alba; petala spatulata, venosa; filamenta dilatata, glabra; ovarium 1-loculare, circiter 12-ovulatum, stylo crasso brevi.

Pratt, 746, 858.

Mr. A. Franchet, to whom I showed this plant, was disposed to regard it as a luxuriant state of *B. uniflora*, Hook. f. & Thoms., but on comparing it with the type of that species I find there are considerable differences, though they are certainly closely allied. *B. uniflora* has not only much smaller almost linear leaves and still shorter scapes, but it is a densely cæspitose plant, whilst *B. sinensis* is invariably unbranched.

Hypericum Prattii, *Hemsl.*

Species *H. chinensi* valde affinis a quo differt foliis ovato-cordatis sessilibus amplexicaulibus, floribus minoribus laxe dichotomo-cymosis.

Szechuen: Min river, *Rev. E. Faber*, 424; without locality, *Dr. A. Henry*, 8808; chiefly near Tachienlu, *Mr. A. E. Pratt*, 381.

Cladrastis sinensis, *Hemsl.*

Foliolis 11–13 oblongo-lanceolatis, petiolo basi incrassato, floribus laxe paniculatis, paniculis multiramosis.

Frutex scandens ? ramis floriferis elongatis flexuosis graciliusculis glabrescentibus. *Folia* imparipinnata, circiter pedalia, distincte petiolata, petiolo basi incrassato cavo gemmam includente; foliola alterna, breviter petiolulata, papyracea, oblongo-lanceolata, $2\frac{1}{2}$–$4\frac{1}{2}$ poll. longa, obtusa vel subacuta, basi rotundata, supra glabra, subtus pallidiora, præcipue secus costam parce ferrugineo-puberula. *Flores* albi, circiter semipollicares, pedicellos graciles æquantes, paniculis folia æquantibus vel longioribus; calyx ferrugineo-pubescens, latus, subæqualiter 5-lobatus, lobis brevissimis; petala longe unguiculata, oblonga, subæqualia, vexillo paullo latiore semper (?) erecto; stamina ima basi coalita; ovarium sessile, parce pilosulum. *Legumen* maturum non visum, planum, rostratum.

Pratt, 129.

Neillia affinis, *Hemsl.*

Species *N. gracili* arcte affinis et forsan ejus varietas sed pluripedalis (saltem 2–3-pedalis) stipulis integris, calycis lobis longioribus, petalis majoribus crispulatis.

Szechuen, *Dr. A. Henry*, 8968; *Mr. A. E. Pratt*, 347.

The foliage of *Neillia gracilis*, *N. sinensis*, *N. rubiflora*, and the present species is so very similar that no specific character can be drawn from it, and it is probable that with a more complete series of specimens connecting links will be found.

Neillia longiracemosa, *Hemsl.*

N. rubifloræ affinis foliis sæpius minoribus nec trilobatis, racemis simplicibus elongatis (usque 6 poll. longis) ebracteatis ? vel si bracteis adsunt citissimo deciduis, calyce tubo fere cylindrico.

Pratt, 730.

This is another instance of very close affinity, but the Chinese plant can hardly be referred to the Indian *N. rubiflora*, Don, unless the combination be carried further.

Rubus allophyllus, *Hemsl.*

R. arctico similis sed foliis simplicibus trilobatis vel trifoliolatis floribus minoribus calyce dense aculeolato vel setoso.

Herba perennis, caulibus debilibus puberulis 2–3-foliatis circiter semipedalibus. *Folia* longe graciliterque petiolata,

tenuia, papyracea, rotundato-cordata, plus minusve distincte trilobata (lobis rotundatis) vel perfecte trifoliolata (foliolis rotundatis breviter petiolulatis), $1\frac{1}{2}$–2 poll. diametro, crebre acuteque denticulata, utrinque præcipue supra parcissime strigillosa, venis primariis paucis sursum ramosis in denticulis abeuntibus; petiolus 2–3 poll. longus; stipulæ membranaceæ, ovato-oblongæ, integræ, vel interdum acute tridentatæ, 3–4 lineas longæ. *Flores* solitarii, pseudoterminales, 8–9 lineas diametro, graciliter pedicellati, pedicellis sæpius setulosis; calycis setosi lobi lanceolati, acuti, recurvi, intus albido-tomentosi; petala perfecta non visa, ut videtur angusta, calycis lobos vix excedentia; stamina numerosissima, filamentis glabris deorsum dilatatis; carpella pauca, glabra. *Fructus* ignotus.

Szechuen: Mount Omei, 3500 to 8000 feet, *Rev. E. Faber*, 521, 560.

Rubus Cockburnianus, *Hemsl.*

R. Idæo affinis caulibus pruinosis, foliolis angustioribus, floribus rubris longe angusteque corymboso-paniculatis.

Caules pluripedales, aculeis brevissimis rectis paucissimis exceptis lævissimi, recti, teretes, solidi. *Folia* pinnata, breviter petiolata, usque ad 9 poll. longa, rhachide gracili nuda vel internodiis 1–2-aculeatis; foliola sæpissime 7 (foliorum supremorum 3), terminali excepto subsessilia, papyracea, lanceolata vel ovato-lanceolata, 2–5 poll. longa, acute acuminata, basi rotundata (terminali sæpius cordato-trilobato, lobis lateralibus parvis), argute serrulata, supra glabra, subtus incana. *Paniculæ* terminales, ad 8 poll. longæ (etiam adsunt corymbi parvi pedunculati in axillis foliorum superiorum), perglabræ, pedicellis gracilibus circiter semipollicaribus, florum superiorum fasciculatis. *Flores* 7–8 lineas diametro; calyx subcoriaceus, extus glaber, intus dense breviterque albo-tomentosus, lobis e basi lata ovata subulato-acuminatis petala excedentibus; petala suborbicularia, brevissime unguiculata, intus parce hirsutula, circiter 2 lineas longa, margine crispulata; discus latus, glaber; carpella juvenilia tantum visa, numerosissima, hirsuta. *Fructus* ignotus.

Pratt, 97.

Rubus pinnatisepalus, *Hemsl.*

R. alceæfolio proximus, a quo differt foliorum lobis rotundatis calycis lobis elongatis alto pinnatisectis.

Rami teretes, graciliusculi, minute setoso-aculeati, simul albido-

tomentosi. *Folia* simplicia, petiolata, papyracea, cordato-orbicularia, 3–4 poll. diametro, breviter 5-lobata, minute creberrimeque denticulata, supra glabrescentia, rugulosa, subtus incana, venis primariis paucisetosis; petiolus teres, 1–2 poll. longus; stipulæ flabellato-pectinatæ, circiter 9 lineas longæ. *Flores* pauci in axillis foliorum fasciculati, brevissime pedicellati, circiter sesquipoll. diametro, bracteis stipulis similibus arcte suffulti; calyx intus extusque tomentosus, extus simul pilis paucis longis albis capitato-glandulosis instructus, lobis quam petala saltem duplo longioribus plus minusve pinnatisectis (segmentis angustissimis) vel eorum 1 vel 2 interdum integris; petala obovato-rotundata, breviter unguiculata, circiter 3 lineas longa, ima basi tantum puberula, venosa; carpella numerosissima, parce pilosula. *Fructus* non visus.

Szechuen: Mount Omei, 9000 to 10,000 feet, *Rev. E. Faber*, 505.

This belongs to the polymorphous group of which the variable *R. moluccanus*, L., is the type.

Rubus spinipes, *Hemsl.*

Nanus, dense aculeatus, caulibus simplicibus unifloris (an semper?) foliis trifoliolatis longissime petiolatis.

Herba perennis, erecta, 6–15 poll. alta, præter flores ubique glabra, caulibus petiolis foliis (subtus secus costam et venas primarias) calycibusque aculeis rectis $\frac{1}{2}$–3 lineas longis præacutis deorsum paullo dilatatis dense armatis. *Folia* cum petiolo usque 10 poll. longa (inferiora vix tripollicaria), pinnatim trifoliolata, foliolis lateralibus multo minoribus a terminali longe disjunctis; stipulæ breviter adnatæ, angustæ, integræ vel paucidentatæ, 6–9 lineas longæ; foliola tenuia, papyracea, terminale ovatum, ovato-oblongum vel oblongum, 1–4 poll. longum, acutum, serrulatum, simul interdum obscure lobulatum, basi rotundatum vel subtruncatum, lateralia subsessilia, oblonga, elliptica vel foliorum inferiorum orbicularia. *Flos* terminalis, 9–12 lineas diametro, pedicello circiter semipollicari; calyx dense aculeatus, tomentosus, intus dense albo-tomentosus, lobis latis ovatis abrupte subulato-acuminatis petala æquantibus vel superantibus; petala ovali-orbicularia, brevissime unguiculata, utrinque hirsuta; carpella numerosissima, juvenilia hirsuta. *Fructus* deest.

Szechuen: *Dr. A. Henry*, 8969.

A very distinct species, similar in foliage to the Indian *R. sik-*

kimensis, Hook. f. It is also near *R. xanthocarpus*, Franchet, which is described as having pilose branches and pubescent leaves and long-clawed petals.

Rosa Prattii, *Hemsl.* (Plate XXX.)

Species pulchra ad gregem *R. macrophyllæ* pertinens, foliolis lineari-lanceolatis maximis vix pollicaribus, floribus minoribus, calycis lobis reflexis.

Rami glabri, rubescentes, inermes vel aculeis paucis mediocribus rectis instructi, ramulis lateralibus floriferis brevibus gracilibus dense foliatis. *Folia* brevissime petiolata, 2–3 poll. longa, rhachide gracillima parce puberula inerma vel interdum aculeis paucis minimis instructa; foliola 11–15, subsessiles, crassiuscula, apiculata, obscurissime denticulata, utrinque secus costam plus minusve puberula, supra glabrescentia, stipulis integris acutis. *Flores* circiter 1 poll. diametro, corymbosi, 3–7 aggregati, rarius solitarii, pedicellis gracilibus circiter 9 lineas longis glanduloso-setosis; calycis tubus anguste urceolatus, dense glanduloso-setosus, lobis e basi lata abrupte caudato-acuminatis intus extusque tomentosis intus albidis interdum apice dilatatis; petala rotundata,emarginata; styli 5, brevissime exserti, hirsuti, carpellis dorso apiceque densissime setosis. *Fructus* ignotus.

Pratt, 116.

A very distinct Rose, easily distinguished by its numerous, small, closely arranged, narrow, obscurely toothed leaflets.

Pleurospermum Franchetianum, *Hemsl.* (Hook. Ic. Pl. t. 2244, ined.)

P. Davidii affine sed differt foliorum segmentis angustioribus bracteis bracteolisque minus dissectis insigniter albo-marginatis.

Perenne vel bienne, erectum, robustum, $1\frac{1}{2}$–2 ped. altum, undique glaberrimum, caulibus simplicibus cavis circiter $\frac{1}{2}$ poll. diametro. *Folia* radicalia non visa, caulina tenuia, fere membranacea, longe petiolata, subtriternatim pinnatisecta, segmentis ultimis linearibus subacutis, maxima 6 poll. longa, petiolo angusto deorsum leviter dilatato; folia superiora sessilia, bracteiformia, paucilobata, umbellas laterales subtendentia. *Umbellæ* compositæ, pluri- vel multiradiatæ, unica sessilis, terminalis, floribus omnibus femineis, cum pluribus (circiter 15) lateralibus confertis longe pedunculatis floribus sæpissime omnibus masculinis; bracteæ

sæpius breviter trifidæ, umbellæ terminali majores sed quam radii fere dimidio breviores, umbellarum lateralium bracteæ radios graciles æquantes vel superantes; bracteolæ integræ, spathulatæ, pedicellos brevissimos superantes, 3–5 lineas longæ. *Fructus* (maturus ignotus) glaber, stylis longis divergentibus coronatus.

Pratt, 552.

This is a very distinct and showy species, and the evident separation of the sexes is interesting. The terminal umbel is sessile and female, and it is surrounded and overtopped by numerous smaller, compound, lateral umbels bearing only male flowers, or possibly occasionally a functionally female flower in the centre. Whether this condition be constant is uncertain; but from a cursory examination of other species of the genus, it would appear that the flowers are commonly functionally unisexual.

Saussurea alatipes, *Hemsl.*, n. sp.

Erecta, foliis amplis sublyratis ovatis basi fere truncatis, petiolo longo dentato vel pinnatifido-alato, capitulis laxe corymbosis, involucri bracteis multiseriatis, acheniis glabris.

Perennis vel biennis, 1–2-pedalis, caule striato puberulo infra medium simplici et folioso, supra medium laxe corymboso-ramuloso et fere nudo, interdum fere simpliciter corymboso. *Folia* papyracea, longe petiolata vel pseudopetiolata, cum petiolo 4–8 poll. longa, suprema minora, maxima $3\frac{1}{2}$ poll. lata, obscure vel grosse calloso-dentata, acute acuminata, supra hispidula, subtus dense breviterque albido-tomentosa. *Capitula* obconica, circiter 25-flora, florentes 8–12 lineas longa lataque; involucri bracteæ parce tomentosæ, anguste lanceolatæ, acutæ vel acuminatæ, sæpe recurvæ, inferiores minutæ, interiores quam flores fere dimidio breviores, omnes plus minusve coloratæ; receptaculi setæ achenia superantes. *Flores* albi vel purpurei (fide *Henry*). *Achenia* matura non visa; pappi setæ uniseratæ, circiter 20, per totam longitudinem plumosæ.

Szechuen: North Wushan, *Dr. Henry*, 7066, 7141.

Saussurea auriculata, *Hemsl.*

S. serratæ similis sed foliis late biauriculatis amplexicaulibus corymbis axillaribus folia vix æquantibus capitulis majoribus.

Perennis? erecta, circiter bipedalis, undique glabra, caulibus simplicibus graciliusculis per totam longitudinem foliosis, internodiis quam folia multoties brevioribus. *Folia* membranacea,

sessilia, patentia, lanceolata, longe acuminata, circiter semipedalia, insigniter apiculato-dentata, costa albida subtus elevata. *Corymbi* plures, 5–8-capitulati, in axillis foliorum superiorum corymbum decompositum foliaceum terminalem formantes. *Capitula* breviter pedunculata, circiter 9 lineas longa, circiter 12-flora; involucri bracteæ multiseriatæ, squamiformes, arcte appressæ, ovatæ, obtusæ, exteriores minores; receptaculi paleæ setiformes, achænia superantes. *Achænia* (matura non visa) angusta, nigro-lineata, glabra; pappi setæ uniseriatæ, circiter 15, longe plumosæ.

Hupeh: Fang at 7000 to 9500 feet, *Dr. A. Henry*, 6789.

Saussurea cirsioides, *Hemsl.*

Ex affinitate *S. Falconeri* sed capitulis multo minoribus numerosioribus confertis.

Perennis vel biennis, erecta, circiter pedalis, caulibus simplicibus crassiusculis parce araneoso-lanatis albidis. *Folia* tenuia, papyracea, deorsum attenuata sed non vere petiolata, angusta, runcinato-pinnatifida, lobis distantibus subacutis, 3–4 poll. longa, plus minusve præcipue subtus incana, caulina pauca, distantia. *Capitula* circiter semipoll. diametro, 2–8 apice caulorum conferta, subsessilia; involucri bracteæ circiter 6-seriatæ, subæquales, ovato-lanceolatæ, subite longeque acuminatæ, acutæ, erectæ, infra medium crassæ, duræ, supra medium herbaceæ, purpureæ, parce pilosæ; receptaculis paleæ setiformes, achænia longe superantes pappum fere æquantes. *Achænia* glabra (matura non visa), brevissima, lata, sursum dilatata; pappi setæ biseriatæ, exteriores breviores, scabridæ, interiores parce plumosæ pilis longissimis.

Pratt, 674.

Saussurea conyzoides, *Hemsl.*

S. salicifoliæ proxima sed robustior ramosior foliis majoribus distincte petiolatis involucri bracteis apice insigniter plumosis.

Perennis vel biennis, erecta, 3–4 ped. alta. *Caules* crassiusculi (infra medium 4–5 lineas crassi), leviter sulcati vel striati, cavi, fere glabri, supra medium tantum ramosi, ramulis brevibus gracilibus sæpissime corymbis 2–3 parvis densis lateralibus cum unico terminali majore gerentibus. *Folia* radicalia non visa, caulina (infima non visa) distincte petiolata, membranacea, lanceolata, acuminata, usque ad 8 poll. longa et 2½ lata (sursum minora, suprema fere bracteiformia), basi cuneata, remote apiculato-denticulata, supra glabra vel glabrescentia, subtus

brevissime incano-tomentosa; petiolus usque ad 1 poll. longus. *Corymbi* simplices vel compositi, partiales maximi vix ultra sesquipoll. diametro. *Capitula* brevissime pedunculata, angusta, semipoll. longa, circiter 6-flora; involucri bracteæ multiseriatæ, exteriores minores squamiformes, omnes obtusæ, interiores apice plumoso-villosæ; receptaculi paleæ setiformes, pappum fere æquantes. *Flores* purpurei (*Henry*). *Achænia* (matura non visa) glabra, brevia; pappi setæ 2-seriatæ, exteriores breviores, simplices, interiores longe plumosæ.

Hupeh: Fang, *Dr. A. Henry*, 7575.

Saussurea cordifolia, *Hemsl.*

Affinis *S. triangulatæ*, foliis amplissimis rotundato-cordatis longissime petiolatis, involucri bracteis latis apice herbaceis.

Perennis vel biennis, erecta, circiter tripedalis, fere undique glabra, caulibus graciliusculis striatis paucifoliatis. *Folia* radicalia non visa, caulina permembranacea, suprema parva ovata excepta, profunde cordata, sinu late aperto, maxima 9 poll. lata, acuminata, grosse apiculato-dentata, supra parcissime strigillosa, subtus pallidiora, petiolo usque ad 8 poll. longo basi dilatato amplexicauli. *Capitula* pauca (circiter 9), longe pedunculata, corymbosa, circiter 1 poll. diametro, pedunculis sulcatis; involucri bracteæ circiter 6-seriatæ, intimæ anguste lanceolatæ exceptæ subæquales, late ovales vel oblongæ, apice parte angusta herbacea, recurva, ciliolata; receptaculi paleæ setiformes, pappum fere æquantes. *Flores* purpurei (fide *Henry*), involucrum vix superantes. *Achænia* glabra, graciles, cylindrica, recta vel exteriores curvata, 3–4 lineas longa; pappi setæ circiter 15, uniseriatæ, per totam longitudinem plumosæ.

Hupeh: Patung district, *Dr. A. Henry*, 414, 5075, and Fang, 6640. Szechuen: South Wushan, *Dr. A. Henry*, 7460.

Saussurea decurrens, *Hemsl.*

Erecta, puberula, foliis e basi angusta subite ovato-oblongis dentatis late decurrentibus, capitulis parvis glabris dense cymoso-corymbosis.

Perennis caulibus subsimplicibus circiter bipedalibus. *Folia* tenuia, 3–6 poll. longa, internodia excedentia, longe acuminata, irregulariter apiculato-dentata, præcipue supra asperula. *Corymbi* laterales et terminales 8-multicapitati, laterales quam folia breviores. *Capitula* circiter 10-flora, breviter pedunculata, 7–9

lineas longa; involucri bracteæ multiseriatæ, glabræ, crassæ, coriaceæ, erectæ, obtusæ, exteriores gradatim breviores, extimæ minutæ, longiores circiter 4 lineas longæ; receptaculum parvum, setis glabris achænia vix æquantibus; corollæ alte 5-lobatæ lobis linearibus, tubo infra antheras angustissimo; antherarum caudæ pilosæ. *Achænia* glabra, compressa, pappo fere æquilonga; pappi setæ biseriatæ, exteriores multo breviores, scabridæ, interiores circiter 20, longe plumosæ, involucrum fere dimidio superantes.

Hupeh: Fang, *Dr. A. Henry*, 6775.

Nearly allied to *Saussurea sachalinensis*, F. Schmidt, and possibly an extreme variety of it, differing in the much more broadly decurrent leaves, glabrous, relatively shorter involucre, and much longer achenes.

Saussurea Henryi, *Hemsl.*

Species eximia ex affinitate *S. Kunthianæ* et *S. taraxacifoliæ*, sed foliis hispidulis (nec argenteo-tomentosis) pinnatipartitis, segmentis mucronulatis.

Herba perennis? caulescens, erecta, $\frac{1}{2}$–2 ped. alta, caulibus graciliusculis supra medium, bracteis paucis exceptis, nudis capitulis 1–3 terminantibus. *Folia* longiuscule petiolata, rigidiuscula, 3–7 poll. longa, pinnatipartita vel alte pinnatifida; segmenta 15–23, anguste oblonga, sæpius 9–12 lineas longa (foliorum inferiorum interdum latiora et paucidentata), patens vel plus minusve deflexa, uninervia, basi dilatata, subtus glabra, interdum purpurascentia. *Capitula* obconica, majora circiter 1 poll. longa lataque; involucri bracteæ multiseriatæ, araneoso-tomentosæ vel fere glabræ, e basi lata subulatæ, plus minusve recurvæ; receptaculum conicum, paleis subulatis achænia superantibus. *Flores* rubri vel purpurei; corollæ lobi longi, lineares. *Achænia* nigra, glabra; pappi setæ sæpius 15, uniseriatæ, a basi plumosa.

Hupeh: North Patung, *Dr. A. Henry*, 7068 A. Szechuen: South Wushan, *Dr. A. Henry*, 7068.

Saussurea populifolia, *Hemsl.*

Habitu foliisque *S. radiatæ*, Franch. (*S. lamprocarpa*, Hemsl.), similis, sed fere omnino glabra, capitulis minoribus, achæniis brunneis striatis.

Caules erecti, 1–2-pedales, 1–5-capitati. *Folia* radicalia non visa, caulina distincte petiolata, sed lamina decurrenti, tenuia, papyracea, cordata subcordata vel ovato-rotundata, basi cuneata,

maxima absque petiolo 4 poll. longa et lata, abrupte longeque acuminata, simul acutissima, crebre apiculato-dentata, lævia, venis primariis lateralibus utrinque circiter 8 cum venulis subgrosse reticulatis subtus sat conspicuis; petiolus anguste alatus, usque 2 poll. longus, foliis paucis supremis subsessilibus. *Capitula* circiter $1\frac{1}{2}$ poll. diametro, longe pedunculata, bracteis paucis foliaceis angustis instructa; involucri bracteæ multiseriatæ, intimæ exceptæ subæquales, lanceolatæ, acuminatæ, supra medium herbaceæ, minute puberulæ, interdum coloratæ, demum recurvæ, interiores erectæ, pappum fere æquantes, lineares, omnino scarioso-coriaceæ, apice plumoso-hirsutæ; receptaculi paleæ setiformes, numerosissimæ, achænia paullo superantes. *Flores* rosei (*A. Henry*). *Achænia* angusta, fere cylindrica, glabra, nigro-lineata, leviter sulcata; pappi setæ circiter 20, uniseriatæ, per totam longitudinem longe plumosæ.

Hupeh: Hsingshan, common on top of mountain at an altitude of 9500 feet, *Dr. A.Henry*, 6942.

Saussurea villosa, *Franch. in Journ. de Bot.* ii. 1888, p. 353, forma major $2\frac{1}{2}$–3 ped. alta, foliis inferioribus pedalibus, caulibus circiter capitulis 8 dense corymbosis.

Hupeh: Hsingshan at 9000 feet, *Dr. A. Henry*, 9762.

This is evidently a fully developed state of Franchet's species, though at first sight it looks very different.

Saussurea Woodiana, *Hemsl.*

Ex affinitate *S. hieracioidei*, a qua differt caule subnullo, foliis sessilibus subtus sericeo-tomentosis, involucri bracteis angustioribus.

Biennis? uniflora, hirsuta. *Folia* pauca, patentia, mollia, crassiuscula, obovato-oblonga vel fere lanceolata, ad 4 poll. longa, obtusa, sinuata, supra parce villosula pilis basi incrassatis, subtus sericeo-tomentosa, argentea. *Capitulum* subsessile, circiter $1\frac{3}{4}$ poll. longum et latum; involucri bracteæ circiter 4-seriatæ, lanceolatæ vel interiores fere lineares, longe acuminatæ, acutissimæ, exteriores circiter pollicares, præcipue supra medium villosæ et purpureo-marginatæ; receptaculi paleæ angustissimæ, fere setiformes, quam achænia breviores; antherarum caudæ longæ, lanatæ. *Achænia* matura non visa, angusta, glabra, fere 3 lineas longa; pappi setæ circiter 15, uniseriatæ, fere pollicares, longissime plumosæ.

Pratt, 452.

This is closely allied to *Saussurea villosa*, Franch., from Yunnan, which was also collected by Przewalski in Western Kansuh, and referred doubtingly by Maximowicz to *S. hieracioides*, Hook. f.

It is named after Mr. T. Wood, of the firm of Drysdale & Co., Shanghai, who rendered Mr. Pratt many kind services and nursed him through an attack of fever.

Primula japonica, *A. Gray*, forma robusta foliis usque ad sesquiped. longis scapo tripedali.

Szechuen, *Dr. A. Henry*, 8879; *Mr. A. E. Pratt*, 130 and 356.

Primula Cockburniana, *Hemsl.*

P. Poissoni similis sed foliis tenuioribus fere obsolete denticulatis, scapo graciliore, floribus minoribus, calycis farinosi dentibus deltoideis, corollæ lobis retusis, bracteis minutis.

Herba perennis, glabrescens, scapo gracili 4–12 poll. alto, floribus in verticillos 2–3 superpositos dispositis, verticillis 3-6-floris. *Folia* tenuia, obovato-oblonga, deorsum attenuata sed non vere petiolata, apice rotundata, 2–4 poll. longa, primum plus minusve pulverulenta, cito glabrescentia, obscure lobulata simul minute denticulata, venis primariis conspicuis. *Flores* circiter 6 lineas longa et 9 lineas lata, pedicellis gracilibus demum fere pollicaribus; calyx anguste campanulatus, circiter 2 lineas longus, dentibus erectis acutis; corollæ glabri tubus cylindricus, lobis obcordatis patentibus venosis. *Capsula* deest.

Pratt, 174.

Easily recognized by its slender habit among the species having superposed whorls of flowers.

The name given to this species is intended to commemorate two gentlemen to whom Mr. Pratt was indebted for much valuable assistance. They are H. Cockburn, Esq., formerly of H.M. Consular Service at Chungking, and the Rev. G. Cockburn, of the Church of Scotland Mission in China. Though of the same name, these gentlemen are in no way related.

Primula nutantiflora, *Hemsl.*

P. soldanelloidei simillima, differt foliis oblongo-spathulatis sessilibus supra medium paucidentatis, subtus pulverulentis, scapo circiter 3–4 lineas sub florum bracteis 2 parvis instructo calycis plus minusve pulverulenti dentibus acutis.

Szechuen: South Wushan, *Dr. A. Henry*, 5584.

This is also near the Himalayan *P. uniflora*, but that has very broad calyx-lobes and a very differently shaped corolla.

Primula Prattii, *Hemsl.*

P. pulchellæ arcte affinis sed minor gracilior, foliis subintegris deorsum valde attenuatis, floribus fere dimidio minoribus flavis, corollæ tubo sursum minus ampliato.

Pratt, 522.

P. pulchella, Franch., is nearer *P. Stuartii*, Wall., but differs according to Franchet (*in schedula*) in the shape of the capsule and in the seeds. Nevertheless there is little or nothing to separate *P. pulchella* from *P. Prattii* beyond what is indicated above.

Lysimachia hypericoides, *Hemsl.*

Puberula erectis, foliis sessilibus ovatis vel oblongo-lanceolatis superioribus alternis, floribus mediocribus axillaribus solitariis, staminibus fere liberis.

Herba perennis, stolonifera, multicaulis, caulibus teretibus simplicibus 6–15 poll. altis. *Folia* omnia sessilia, opposita, vel superiora sub floribus alterna, papyracea, plus minusve puberula (infima multo minora fere rotundata, semiamplexicaulia, hirsuta), obtusa vel acuta, $\frac{1}{2}$–2 poll. longa (sursum gradatim longiora), minutissime punctata (punctis fere obsoletis), vena inconspicua intramarginali instructa. *Flores* flavi (*A. Henry*), circiter semipoll. diametro, pedicellis filiformibus quam folia circiter dimidio brevioribus; sepala crassiuscula, extus hirsutula, lineari-lanceolata vix acuta, quam corolla triente fere breviora; corollæ rotatæ eglandulosæ segmenta late obovato-rotundata, venosa; stamina glabra, filamentis ima basi tantum connatis; ovarium glabrum. *Capsula* non visa.

Hupeh: Chienshih, *Dr. A. Henry*, 5842.

Of erect or suberect habit, with foliage resembling *Hypericum hirsutum*, and flowers very similar to those of *Lysimachia nemorum*, though rather smaller.

Lysimachia omeiensis, *Hemsl.*

Erecta, parcissime puberula, foliis omnibus oppositis sessilibus membranaceis ovatis, floribus axillaribus solitariis, corollæ segmentis lanceolatis acutis.

Herba perennis, ut videtur multicaulis, caulibus teretibus simplicibus circiter pedalibus. *Folia* infima squamiformia, sursum

gradatim majora, maxima vix 2½ poll. longa acuta, minutissime punctata, glabrescentia. *Flores* 6–8 lineas diametro, pedicellis gracillimis quam folia brevioribus; sepala angustissima, acuta, quam corolla paullo breviora, extus hirsutula; corolla rotata, eglandulosa, venosa; stamina vix monadelpha; ovarium glabrum. *Capsula* deest.

Szechuen: mount Omei, 9000–11,000 feet, *Rev. E. Faber*, 224.

One of the very few species of erect habit with simple stems and solitary axillary flowers. The latter are similar to those of *L. nemorum*, but the corolla-lobes are narrower and acute.

Lysimachia nigrolineata, *Hemsl.*

Gracilis, adscendens, hirsuta, foliis alternis petiolatis parvis ovatis, floribus parvis axillaribus solitariis insigniter nigrolineatis.

Herba perennis (?), ut videtur multicaulis, caulibus gracilibus 6–9 poll. longis, internodiis quam folia brevioribus. *Folia* alterna, longe petiolata, papyracea, molliter hirsuta vel villosa, ovata, lamina secus petiolum decurrentia, 5–10 lineas longa, obtusa, crebre nigrolineata. *Flores* flavi, axillares, solitarii, 6–8 lineas diametro, pedicellis filiformibus folia paullo superantibus; sepala anguste lanceolata, acuminata, corollam fere æquantia, tenuia, extus præcipue infra medium villosula, conspicue nigrolineata; corollæ rotatæ segmenta late ovalia, obtusa, conspicue nigrolineata; stamina breviter monadelpha; ovarium villosum. *Capsula* ignota.

Nanking: coll. C. Schmidt, comm. *Rev. E. Faber*, n. 1602.

A very distinct species, resembling some of the species of *Saxifraga* of the *Hirculus* group.

Lysimachia involucrata, *Hemsl.* (Plate XXXI.)

Procumbens vel adscendens, fere omnino glabra, foliis oppositis, floribus dense cymosis vel pseudocapitatis, cymis paucifloris axillaribus longe pedunculatis sub floribus bracteis amplis instructis.

Herba perennis (palustris?), caulibus elongatis saltem 2–3-pedalibus debilibus, internodiis quam folia longioribus. *Folia* opposita, membranacea, primum parcissime puberula, distincte petiolata, ovato-lanceolata, acute acuminata, cum petiolo 2–3 poll. longa, basi rotundata vel subcuneata, glandulis nigris lineolatis crebre conspersa, venis primariis utrinque circiter 5 arcuatis juxta marginem inter se anastomosantibus. *Bracteæ* foliaceæ

(rectius folia minora conferta), petiolatæ, oppositæ vel subsessiles, late ovatæ vel fere orbiculares, acuminatæ, flores æquantes vel superantes, ciliolatæ. *Flores* flavi, circiter 9 lineas diametro, 4–6 ad apices ramulorum axillarum congesti, pedunculo (seu internodio basilari) folia sæpissime superanti; sepala parce hirsutula, anguste lanceolata, acuta, corollam æquantia; corolla glabra, campanulata, lobis tubo æqualibus; stamina glabra, fere medio monadelpha; ovarium hirsutum.

Szechuen, *Dr. A. Henry*, 8884; *Mr. A. E. Pratt*, 410.

The quasi-capitate flowers with large leafy bracts sufficiently characterize this species.

Lysimachia longipes, *Hemsl.* (Plate XXXII.)

Erecta, undique glaberrima, foliis ovatis sessilibus, floribus mediocribus laxe racemoso-corymbosis, corymbis longe graciliterque pedunculatis, pedunculis nudis.

Herba perennis (?), saltem bipedalis, caulibus subsimplicibus albidis politis. *Folia* opposita, sessilia, membranacea, ovata, 2–4 poll. longa, longissime acutissimeque acuminata, basi rotundata, undique obscure punctata, simul juxta marginem conspicue glanduloso-punctata, subtus glauca, venis primariis lateralibus paucis haud conspicuis. *Flores* albi vel flavi, 6–8 lineas diametro, longe pedicellati; corymbi axillares et terminales, folia superantes, sæpius 6–8-flori, pedunculis gracillimis simul rigidis ebracteatis; pedicelli filiformes 1–1½ poll. longi, bracteolis setaceis; sepala subcarnosa, lineari-lanceolata, acuminata, corollam superantia, intus lineis paucis glandulosis crassis instructa; corollæ rotatæ segmenta ovato-lanceolata, densissime lineata; stamina alte monadelpha; ovarium glabrum. *Capsula* quam calyx persistens fere dimidio brevior, 5-valva.

Ningpo mountains, *Rev. E. Faber*, n. 1638.

In foliage this resembles the alternate-leaved *L. Fœnum-græcum*, Hance, and *L. simulans*, Hemsl., but the racemose-corymbose inflorescence is very different.

Salvia (§ Drymosphace) Prattii, *Hemsl.*

Species ex affinitate *S. hiantis*, differt foliis omnibus cordato-oblongis (nec sagittatis aut hastatis) regulariter crenatis floribus majoribus calyce non viscoso.

Perennis, erecta, robusta, vix sesquipedalis, caulibus simplicibus parce villosulis. *Folia* papyracea, graciliter petiolata, cordato-

oblonga vel cordato-ovata, lobis rotundatis, absque petiolo $1\frac{1}{2}$–$2\frac{1}{2}$ poll. longa, obtusa, minute crenulata, utrinque præcipue subtus parce pubescentia, supra obscure punctato-glandulosa, inferiorum petiolis 4–5 poll. longis. *Verticillastri* circiter 6-flori, conferti, bracteis bracteolisque obovato-rotundatis striatis villosulis maximis calycem paullo superantibus. *Flores* rubri vel purpurei, bipollicares, nutantes; calycis villosuli labium superius integrum, inferius breviter bidentatum; corollæ tubus ampliatus, leviter curvatus, labio superiore parvo leviter incurvo compresso emarginato, labio inferiore trilobato, lobo intermedio latissimo; stamina glabra, fauce tubi inserta, filamentis dilatatis connectivi ramis subæqualibus.

Pratt, 491, 546.

Oxyria sinensis, *Hemsl.* (Plate XXXIII.)

Ab *O. digyna* differt caule folioso inflorescentiæ magis divaricatis fructu latiore quam longo stigmatibus sessilibus.

Herba, ut videtur, perennis, erecta, circiter bipedalis, caule valido striato hispidulo infra inflorescentiam simplici. *Folia* radicalia non visa, caulina distincte petiolata, crassa, subcarnosa, opaca, rotundato-cordata vel fere reniformia, $1\frac{1}{2}$–2 poll. lata, glabra, undulata simul minutissime crispata, interdum obscure lobulata, venis paucis inconspicuis; petiolus 1–2 poll. longus, basi in ochream latam tubulosam truncatam expansus. *Flores* hermaphroditi, racemoso-paniculati, fasciculati pedicellis capillaribus 2–3 lineas longis; panicula densa, circiter 9 poll. longa, bis terque ramosa, hispidula, bracteis minutissimis. *Perianthium* minutum, fructiferum vix auctum, segmentis 2 exterioribus demum reflexis, 2 interioribus majoribus oblongis nucem arcte appressis; stamina 6 quam perianthium fere dimidio breviora. *Nux* late bialata.

Pratt, 779.

A very distinct species easily recognized by its stout leafy stem. It is worthy of note that the very widely spread *Oxyria digyna*, Hill, the only other known species of the genus, has not hitherto been found either in China proper or Japan; yet it occurs in the mountains of Northern India and in the island of Saghalien. It is also spread all round the arctic regions and extends southward in the mountain-ranges of both eastern and western North America, to the Pyrenees and Alps in Europe, and to the mountains of Syria in Western Asia.

Daphne retusa, *Hemsl.*

D. odoræ arcte affinis sed foliis crassis subcarnosis emarginatis sat differt.

Frutex densissime ramosus, ut videtur nanus, ramis brevibus crassis apice tantum foliosis inter folia fulvo-hirsutis. *Folia* conferta, sessilia vel subsessilia, crassa, coriacea vel subcarnosa, glabra, siccitate corrugata, oblonga vel anguste obovata, 6–15 lineas longa, leviter emarginata simul rotundata, basi vix cuneata, margine revoluta, venis immersis obscurissimis. *Flores* ad apices ramorum sessiles, subcapitati, bracteis obovato spathulatis quam flores dimidio brevioribus cito deciduis; perianthium subcarnosum, glabrum, circiter 9 lineas longum et diametro, lobis latis fere rotundatis venosis, tubo crasso corrugato; stamina 4 superiora breviter exserta; ovarium glabrum, stigmate sessili. *Bacca* ignota.

Pratt, 737.

I was at first disposed to treat this as a stunted mountain form of *Daphne odora*, Thunb., but the very thick, small, emarginate leaves are so very different that it is easily distinguished.

Calanthe ecarinata, *Rolfe.*

Folia obovato-oblonga, brevissime et abrupte acuminata, basi attenuata, 3–5 poll. longa, $1\frac{1}{2}$–$2\frac{1}{2}$ poll. lata. *Scapus* 1 ped. altus, puberulus, circa 10-florus. *Bracteæ* ovato-lanceolatæ, acuminatæ, $2\frac{1}{2}$–3 lin. longæ. *Pedicelli* 6 lin. longi. *Sepala* oblongo-lanceolata, brevissime acuminata, 6–7 lin. longa. *Petala* sepalis similia, angustiora. *Labellum* columna adnatum, sessile, ecalcaratum, trilobum, ecarinatum, lobo medio flabellato-rotundato obtuso $2\frac{1}{2}$ lin. diametro, lobis lateralibus orbiculari-oblongis $1\frac{1}{2}$ lin. longis. *Columna* brevis, lata.

Pratt, 765.

Closely allied to *C. tricarinata*, Lindl., but with the front lobe of the lip quite sessile, and without the slightest trace of the conspicuous keels of that species, in which also the front lobe of the lip is distinctly stalked and the side lobes laterally attached to the same.

Calanthe buccinifera, *Rolfe.*

Folia breviter petiolata, obovato-oblonga, breviter acuminata, basi attenuata, 4–12 poll. longa, $1\frac{1}{2}$–$2\frac{1}{2}$ poll. lata. *Scapus* 1–$1\frac{1}{2}$ ped. altus, glabrus, multiflorus. *Bracteæ* lineari-lanceolatæ,

acuminatæ, 6–10 lin. longæ. *Pedicelli* 6–9 lin. longi. *Sepala* oblongo-lanceolata, acuminata, 9–11 lin. longa, $2\frac{1}{2}$–3 lin. lata. *Petala* sepalis similia, minora. *Labellum* integrum, rotundato-flabellatum, fimbriatum, 7–8 lin. latum, utrinque ad apicem columnæ adnatum, basi in calcar $\frac{3}{4}$–1 poll. longo gradatim attenuatum, disco lævi. *Columna* clavata, 5 lin. longa.

Pratt, 72, 102, 683. Prov. Hupeh, *Henry*, 6064, 7161. Mt. Omei, Szechuen, at 5000 feet alt., *Faber*, 953.

A very distinct species, most nearly allied to the Himalayan *C. alpina*, Hook. f., which, however, has smaller, very differently coloured flowers and a much shorter spur. The flowers of the present species appear to be a somewhat uniform rose-purple. The lip is much like that of some species of *Galeandra*, except that its margins are adnate to the sides of the column.

Habenaria camptoceras, *Rolfe*.

Planta pusilla, $2\frac{1}{2}$–3 poll. alta. *Folia* bina, radicalia, elliptico- v. lanceolato-ovata, subacuta, $\frac{3}{4}$–$1\frac{1}{4}$ poll. longa, 2–6 lin. lata. *Scapus* uni- v. biflorus. *Bracteæ* ovato-lanceolatæ, acuminatæ, 5–8 lin. longæ. *Sepalum* posticum erectum, late ovatum, obtusum, concavum, 4 lin. longum; sepala lateralia erecta, obliqua, late semicordata, obtusa, trinervia. *Petala* cum sepalo postico in galeam conniventia, lanceolato-linearia, obtusa, binervia, $\frac{3}{4}$ lin. lata. *Labellum* trilobum, 6–7 lin. longum; lobus medius late ellipticus, obtusissimus, 4 lin. latus, repando-crenulatus; lobi laterales oblongo-lineares, subfalcati, obtusi, 3 lin. longi, 1 lin. lati; calcar 8–9 lin. longum, crassiusculum, curvatum, apice clavatum, obtusissimum. *Columna* brevis, stigmata brevissima.

Pratt, 305.

A most distinct species, with the habit of *H. Aitchisoni*, Rchb. f., but with fewer and many times larger flowers and erect lateral sepals. This nevertheless appears to be its true affinity.

Cypripedium himalaicum, *Rolfe*.

Erecta, $\frac{1}{2}$–$1\frac{1}{4}$ ped. alta. *Folia* ovato- v. elliptico-oblonga, brevissime acuminata, 2–4 poll. longa, 1–$2\frac{1}{4}$ poll. lata. *Sepalum* posticum ovatum, acuminatum; lateralia connata, paullo angustiora. *Petala* ovato-lanceolata, acuminata, sepalis æqualia. *Labellum* subglobosum, $\frac{3}{4}$–$1\frac{1}{4}$ poll. longum. *Staminodium* subcordato-ellipticum, subacutum, 3–4 lin. longum.—*C. macranthon*, Hook. f., Fl. Brit. Ind. vi. p. 170, ex parte, *non* Sw.

Pratt, 748.—Also Lachen, Sikkim, 11,500–12,000 feet alt., *J. D. Hooker*; Hill above Jhala, Tihri Garhwal, 12–13,000 feet, *Duthie*, and opposite Budhi village, in Nepal, 11–12,000 feet, *Duthie*.

Allied to *C. macranthon*, Sw., but far smaller in all its parts, with various small structural differences and quite different colours. The flowers measure $1\frac{1}{4}$–$2\frac{1}{4}$ inches in diameter, the sepals and the petals are light yellow, veined with brownish red, and the lip maroon-purple.

Cypripedium tibeticum, *King, in herb. Kew.*

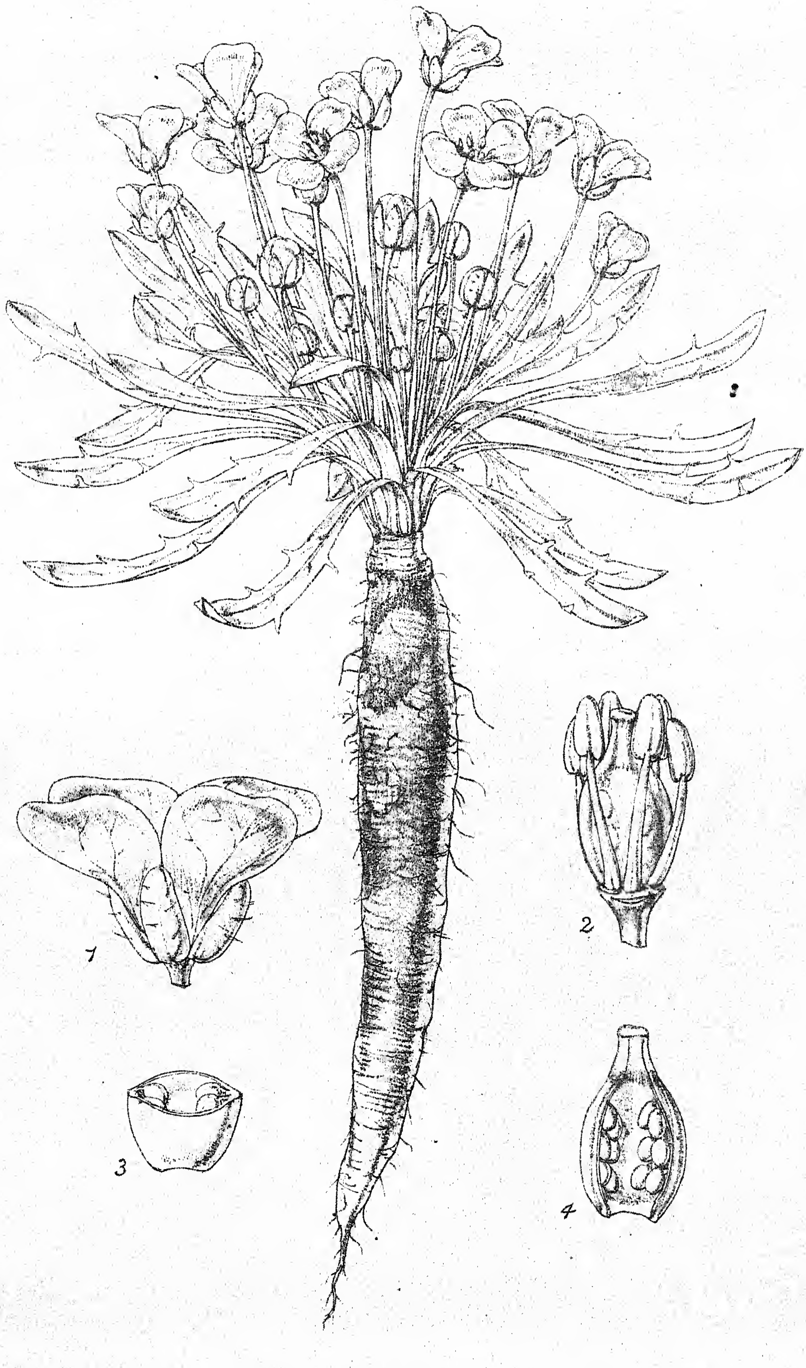
Erecta, $\frac{1}{2}$–$1\frac{1}{4}$ ped. alta. *Folia* elliptico-oblonga, subobtusa v. brevissime acuminata, 2–$5\frac{1}{2}$ poll. longa, 1–$2\frac{3}{4}$ poll. lata. *Sepalum* posticum ovatum, breviter acuminatum; lateralia connata similia. *Petala* lanceolato-ovata, breviter acuminata, sepalis æqualia. *Labellum* subglobosum, 1–$1\frac{1}{2}$ poll. longum. *Staminodium* late cordato-ovatum, obtusum, 5–6 lin. longum.—*C. macranthon* var. *ventricosa*, Hook. f. Fl. Brit. Ind. vi. p. 170, ex parte, *non* Carr.

Pratt, 14, 42, 301, 736.—Also Chumbi and Phari, collected by Dungboo, and communicated by Dr. King.

Allied to the Siberian *C. macranthon*, Sw., but with far shorter and broader petals, a different staminode and other peculiarities, as well as quite different colours. According to Dr. King's Calcutta drawing the sepals and petals are nearly white, passing into light yellow at the apex, all the nerves being maroon-purple with a few transverse reticulations. The lip and staminode are maroon-purple, the latter being much darker round the mouth. The flowers measure three to four inches in diameter, and the veinings of the sepals and petals are very apparent in the dried specimens.

Arisæma parvum, *N. E. Brown.*

Tubere parvo, $\frac{1}{2}$–$\frac{3}{4}$ poll. diam.; folii solitarii petiolo 3–7 poll. longo, lamina trisecta, segmentis omnibus sessilibus, lateralibus $1\frac{1}{2}$–$2\frac{1}{2}$ poll. longis suboblique ovatis acuminatis, intermedio duplo breviore $\frac{3}{4}$–$1\frac{1}{4}$ poll. longo et lato late obovato vel obcordato apice subtruncato vel emarginato apiculato basi cuneato; scapo 2–4 poll. longo; spathæ tubo 1–$1\frac{1}{4}$ poll. longo atro-purpureo, lamina $1\frac{1}{4}$–$1\frac{3}{4}$ poll. longa lanceolata acuta vel acuminata procurva viridi basi albo-striata; spadicis unisexualis appendice



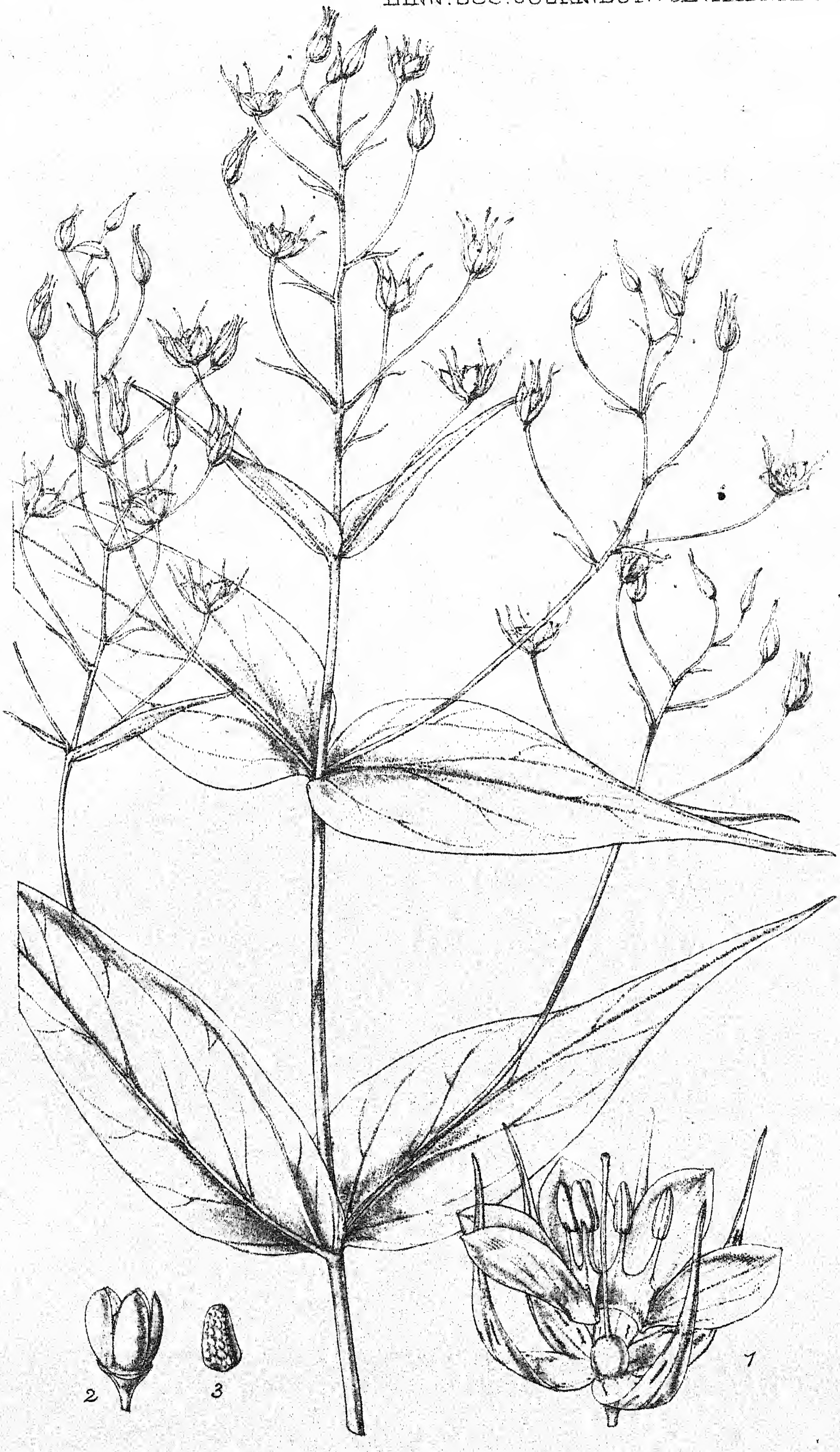
C.H.Fitch del. et Lith. BRAYA SINENSIS, *Hemsley*. J.N.Fitch imp.

C.H.Fitch del. et lith.

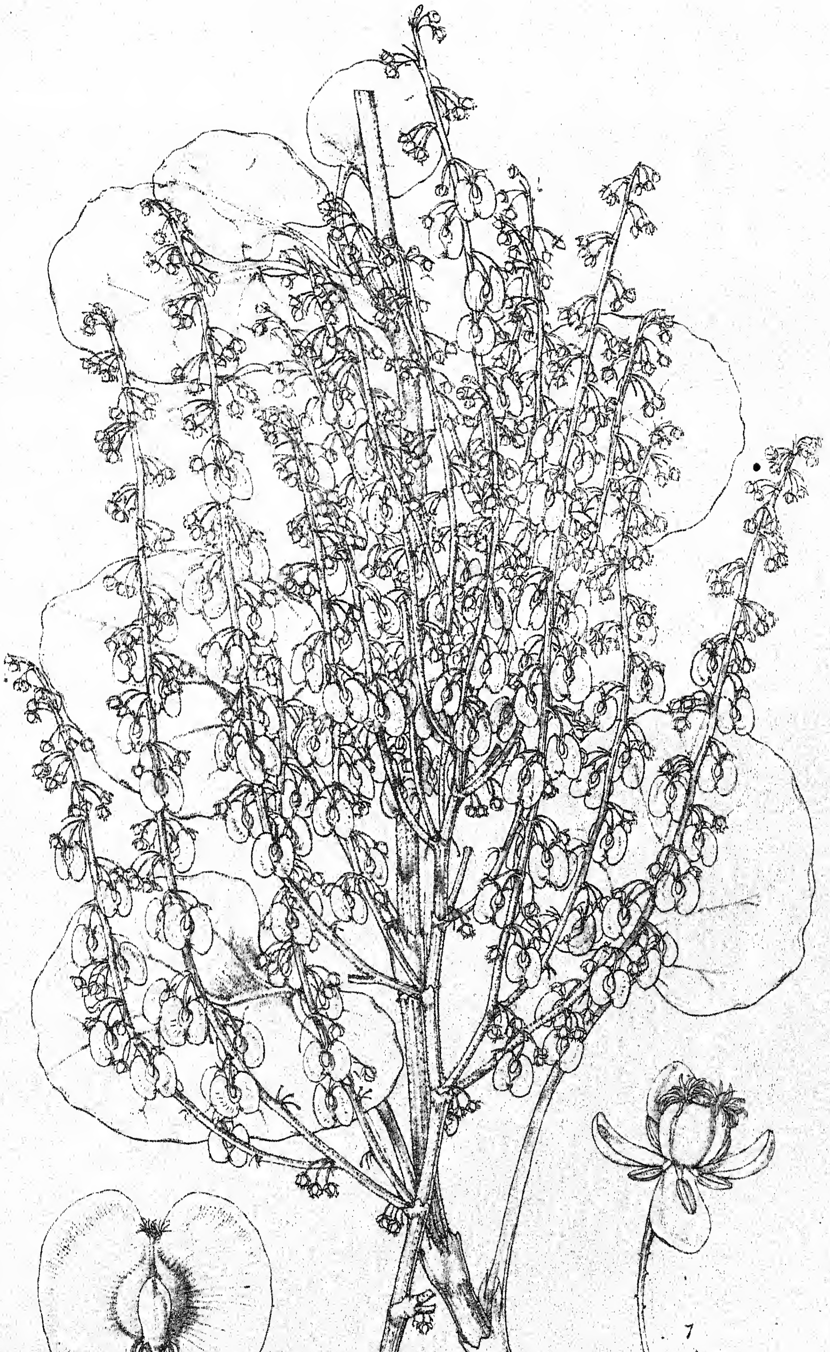
ROSA PRATTII, *Hemsley.*

J.N.Fitch imp.

C.H. Fitch del. et lith.　LYSIMACHIA INVOLUCRATA, *Hemsley*.　J.N. Fitch imp.



C.H. Fitch del. et lith. LYSIMACHIA LONGIPES, *Hemsley.* J.N. Fitch imp.



C.H. Fitch del. et lith.

OXYRIA SINENSIS, *Hemsley.*

J.N. Fitch imp.

tenue quam spatha paullo breviore substipitata basi abrupte annulato-incrassata apice e fauce usque ad tubæ medium decurva.

Pratt, 841.

This is the smallest species in the genus at present known, and is easily recognized by its small size and by the middle leaflet being much smaller than the side leaflets.

Arisæma pictum, *N. E. Brown.*

Tubere depresso-globoso, $1\frac{1}{2}$ poll. diam.; folii solitarii petiolo $1\frac{1}{2}$–2 ped. longo viridi vittis brevibus confluentibus purpureis e basi ad apicem pulchre picto, lamina trisecta, segmentis lateralibus sessilibus $5\frac{1}{2}$–9 poll. longis, 2–4 poll. latis oblique ovatis attenuato-acuminatis basi obtusissime rotundatis vel fere subtruncatis, intermedio longe stipitato (stipite $1\frac{1}{2}$–$2\frac{1}{4}$ poll. longo) late elliptico 4–7 poll. longo $2\frac{1}{2}$–4 poll. lato acuminato basi subtruncato; scapo petiolo breviore 14–18 poll. longo purpureo variegato; spathæ tubo $1\frac{3}{4}$–$2\frac{1}{4}$ poll. longo cylindrico, lamina ovato-lanceolata longe caudata 4–5 poll. longa purpurea vittata?; spadice unisexuali 2–$2\frac{3}{4}$ poll. longo, spathæ tubo raro excedens, appendice stipitata inferne incrassata truncata superne leviter clavata obtusa.

Pratt, 61.

Besides the character of its inflorescence this may be recognized from all hitherto described species by the middle leaflet having a long stalk whilst the lateral leaflets are sessile.

Adiantum Prattii, *J. G. Baker.*

Rhizoma gracile, late repens, stipitibus nudis semipedalibus. *Frondes* deltoideæ, tripinnatæ, glabræ, 5–6 poll. longæ et latæ; pinnæ infimæ maximæ, latere inferiore valde producto; segmenta ultima 2–4 lineas lata, dimidio superiore rotundato sterili inciso, dimidio inferiore cuneato, lateralia brevissime petiolulata. *Sori* sæpissime solitarii; indusium glabrum, oblongum, persistens, $1\frac{1}{2}$–2 lineas longum.

Pratt, without number.

Allied to *A. monochlamys* and *A. venustum.*

EXPLANATION OF THE PLATES.

PLATE XXIX.

A plant of *Braya sinensis*, Hemsl., natural size.

Fig. 1, a flower; 2, the same with the sepals and petals removed; 3, ovary in cross section; 4, ditto in vertical section: all enlarged.

PLATE XXX.

A branch of *Rosa Prattii*, Hemsl., natural size.
Fig. 1, section of a flower; 2, a carpel: both enlarged.

PLATE XXXI.

A branch of *Lysimachia involucrata*, Hemsl., natural size.
Fig. 1, portion of a leaf; 2, a flower laid open: both enlarged.

PLATE XXXII.

A branch of *Lysimachia longipes*, Hemsl., natural size.
Fig. 1, a flower laid open; 2, a capsule opened; 3, a seed: all enlarged.

PLATE XXXIII.

Portions of a plant of *Oxyria sinensis*, Hemsl., natural size.
Fig. 1, a flower; 2, a fruit: both enlarged.

LICHENES EPIPHYLLI SPRUCEANI, a cl. SPRUCE in regione Rio Negro lecti, additis illis a cl. TRAIL in regione superiore Amazonum lectis, ex hb. Kewensi recenter missi, quos exponit Dr. J. MUELLER. (Communicated by W. T. THISELTON DYER, F.R.S., F.L.S., &c.)

[Read 5th May, 1892.]

Trib. PANNARIEÆ.

1. COCCOCARPIA ÆRUGINOSA, *Muell. Arg. Revis. Lich. Féeanor.* p. 16; ad folia Palmarum minorum, Montana de Javita in regione Rio Negro, *Spruce*, n. 631.

2. COCCOCARPIA TENUISSIMA, *Muell. Arg. in Flora*, 1883, p. 354; in foliis Dicotyledon. ad San Gabriel, *Spruce*, n. 486.

Trib. LECANOREÆ.

3. LECANIA BICOLOR, *Muell. Arg.*; thallus glauco-albidus, maculari tenuis, continuus, granulis flavescenti-albidis tantum circ. $\frac{1}{10}$ mm. latis paullo irregulariter hemisphæricis dense sparsis ornatus, demum facile evanescens aut tantum granulis repræsentatus; apothecia circ. $\frac{1}{3}$ mm. lata, plana, crassiuscula, persistenter

lecanorina; margo albidus, obtusus et integer, tumidulus, demum extenuatus; discus fuscus et nudus; lamina hyalina; hypothecium fulvo-fuscum; sporæ in ascis 8næ, circ. 15 μ longæ et $3\frac{1}{2}$ μ latæ, digitiformes, 4-loculares.—Apothecia ut in *Lecania micrommata*, Muell. Arg., at thallus minute granuliger. — Prope San Gabriel ad Rio Negro, *Spruce*, nn. 490, 501, 566.

4. Calenia lacerata, *Muell. Arg.*; thallus albidus, minute macularis; maculæ circ. 2 mm. latæ, e centro astroideo-laceratæ, lacinulæ spuriæ irregulariter pinnatipartitæ aut subpalmati-lobæ et anguloso-crenatæ, obtusæ, omnes planissimæ et valde tenues; gonidia globosa; apothecia $\frac{2}{10}$ mm. lata, hemisphærica, cum thallo concolora et ab eo obtecta, poro aperientia.—Apothecia juniora tantum visa, omnino analoga junioribus *Caleniæ pulchellæ*, Muell. Arg. Sporæ haud evolutæ.—Ad Rio Negro, *Spruce*, n. 529.

5. Calenia pulchella, *Muell. Arg. Lich. Epiphylli*, n. 3; in foliis Dicotyledon. prope Barra ad Rio Negro, *Spruce*, nn. 544, 598, 601.

6. Calenia lævigata, *Müll. Arg.*; thallus albidus, orbicularis, tenuissimus, polito-lævigatus; gonidia globosa; apothecia $\frac{1}{5}$–$\frac{1}{4}$ mm. lata, adpresso-sessilia, nano-hemisphærica, cum thallo concolora, regularia et lævigata, juniora poro aperientia et speciem *Ocellulariæ* simulantia, dein modice aperta; margo crassulus et integer, obtusus; discus exiguus, depressus; lamina tota hyalina; paraphyses valde tenellæ et creberrime intricatim connexæ; sporæ in ascis solitariæ, hyalinæ, circ. 70 μ longæ et 7 μ latæ, utrinque obtusæ, circ. 16-loculares, triente superiore aut parte dimidia in asco infracto-recurvæ.—Similis *C. pulchellæ*, Muell. Arg., at sporæ ut in *C. depressa* et *C. Puiggarii*, Muell. Arg. L. Epiph. nn. 4 et 5, sed tenuiores, et apothecia multo minora quam in proxima *C. depressa*, ubi cæterum apothecia late aperta et discus magis carneus.—Ad folia Filicum et Palmarum in reg. super. flum. Amazonum, *Trail.*

7. Gyalectidium filicinum, *Muell. Arg. in Flora*, 1881, p. 101; in reg. super. Flum. Amazonum, *Trail*; ad Rio Negro, *Spruce*, n. 617; ad San Gabriel, *Spruce*, nn. 483, 563.

Trib. LECIDEEÆ.

8. LECIDEA (§ BIATORA) TRAILIANA, *Muell. Arg.*; thallus tenuissime macularis, olivaceo-pallidus, continuus (parum perspicuus), granulis hemisphæricis $\frac{1}{10}$ mm. latis sparsis flavescenti-pallidis conspersus; gonidia globosa, glomeruloso-cohærentia; apothecia sicca subcarneo-aurantiaca, madefacta tota flavescenti-pallida, evoluta $\frac{1}{2}$ mm. lata, plana; margo haud prominens et integer; lamina undique hyalina; paraphyses subsegregabiles; asci cylindracei, 8-spori; sporæ 11–13 μ longæ et 6–8 μ latæ, ovoideæ et ellipsoideæ.—Species inter Lichenes epiphyllos sporis simplicibus insignita, quodammodo *Lecanoram Bouteillei*, Desmaz., in mentem revocans, sed apothecia biatorina et thallus alius.—In foliis Palmarum minorum in reg. sup. Amazonum, *Trail.*

9. LECIDEA (§ BIATORA) PIPERIS, *Spreng.* v. MINIATA, *Muell. Arg.*—Lecidea miniata, *Fée in Bull. Soc. bot. de France*, 1873, p. 313.—In reg. sup. fl. Amazonum, *Trail* (alibi in Brasilia ad cortices lecta).

10. PATELLARIA (§ BILIMBIA) SORORCULA, *Muell. Arg. in Bull. Soc. Bot. Belg.* xxx. p. 69; in foliis Monocotyl. in reg. sup. Amazonum, *Trail.*

11. PATELLARIA (§ BILIMBIA) SUBPULCHRA, *Muell. Arg. Lich. Epiphyll.* n. 8.—In fol. Filicum in reg. sup. Amazonum, *Trail*; et in foliis variis secus Rio Negro prope Panuré, *Spruce*, n. 578; et ibid. in Montana de Javita, *Spruce*, n. 629.

12. PATELLARIA (§ BILIMBIA) LEIOPLACELLA, *Muell. Arg.*; thalli maculæ cæsio-glaucæ, tenuissimæ, planæ, anguloso-suborbiculares et obtuse lobatæ, circ. 2 mm. latæ, hinc inde confluentes, totæ læves, haud granuligeræ; apothecia circ. $\frac{3}{4}$ mm. lata, plana, semper prominenter marginata, juniora sublecanorina, margine cæsio-albido cincta, dein biatorina; margo extus halone albido præditus, integer, intus linea zeorino-fuscescente ornatus; discus carneus et nudus; lamina hyalina; hypothecium fuscum; sporæ in ascis 8næ, circ. 13–15 μ longæ et $3\frac{1}{2}$–4 μ latæ, late digitiformes, 4-loculares.—Thallus ut in *P. filicina*, Muell. Arg., sed discus apotheciorum ut sic *P. subpulchra*, Muell. Arg.—Secus Rio Negro prope San Gabriel, *Spruce*, n. 470.

13. PATELLARIA (§ BILIMBIA) GABRIELIS, *Muell. Arg.*; thallus albidus, subtiliter deplanato glebulosus, glebulæ perexiguæ, plus minusve in thallum tenuissimum continuum haud granuligerum confluentes; apothecia $\frac{2}{8}$–$\frac{3}{8}$ mm. lata, plana; margo obsolete prominens et disco cinnamomeo-carneo pallidior, integer, extus lævigatus et nudus; lamina hyalina; hypothecium pallido-fulvum; sporæ 8næ, 10–13 μ longæ et 4 μ latæ, cylindrico-obovoideæ, 4-loculares.—A proxima *P. leioplacella*, Muell. Arg., differt thalli colore et structura et apotheciis non sublecanorinis.—In foliis Palmarum minorum prope San Gabriel ad Rio Negro, parcissime lecta, *Spruce*, n. 465.

14. PATELLARIA (§ BILIMBIA) PSYCHOTRIÆ, *Muell. Arg. in Flora*, 1881, p. 229; thallus, hucusque ignotus, est disperso-granularis; granula albida, hemisphærica, $\frac{13}{100}$ mm. lata et minora.—In foliis Palmarum et Filicum in reg. sup. flum. Amazonum, *Trail.*

15. PATELLARIA (§ BILIMBIA) STANHOPIÆ, *Muell. Arg. in Flora*, 1881, p. 229; in fol. Palmarum minorum, reg. sup. Amazonum, *Trail.*

16. PATELLARIA (§ BILIMBIA) LEUCOBLEPHARA, *Muell. Arg. in Flora*, 1881, p. 110; in foliis Palmarum ad flum. Amazonum, *Trail*; et prope San Gabriel ad Rio Negro in fol. Dicotyled., *Spruce*, n. 492 (cæterum ad cortices in Brasilia haud rara).

17. PATELLARIA (§ BILIMBIA) CÆSIELLA, *Muell. Arg.*; thallus cæsio-albus, maculari-tenuissimus, subreticulatim interrupto-confluens, lævis; apothecia $\frac{3}{20}$–$\frac{4}{20}$ mm. lata, arcte sessilia; margo pallidus, vix prominens, extus obsolete floccoso- v. piloso-ciliatus, disco multo pallidior; discus fuscus et nudus; asci angusti, 8-spori; sporæ 15 μ longæ, 3 μ latæ, fusiformes, 3-loculares.—Proxima *Patellari atricholoma*, Muell. Arg., recedit thallo omnino aliter colorato rufescenti-fusco vel virente, nec cæsio-albo.—In foliis Palmarum minorum in reg. sup. flum. Amazonum, *Trail.*

18. PATELLARIA (§ BILIMBIA) TRICHOLOMA, *Muell. Arg. in Flora*, 1890, p. 189.—Biatora tricholoma, *Mont. in Ann. Sci. Nat.* sér. III., xvi. p. 53, *Syllog.* p. 339.—In fol. Palmarum minorum in reg. sup. flum. Amazonum, *Trail.*

19. PATELLARIA (§ BILIMBIA) FUMOSO-NIGRICANS, *Muell. Arg. L. Epiphyll.* n. 14; prope Barra ad Rio Negro, *Spruce*, n. 606.

20. PATELLARIA (§ BILIMBIA) DEPLANATA, *Muell. Arg. L. Epiph.* n. 17 (an eadem ac *Platygrapha homata*, Stirt. ?); in foliis Palmarum minorum in reg. super. flum. Amazonum, *Trail*.

21. PATELLARIA (§ BILIMBIA) DIFFLUENS, *Muell. Arg.*; thallus virenti-albus, maculari-tenuissimus, tenuiter granuliger; gonidia globosa; apothecia 1 mm. lata, tenuissime membranuliformia, orbicularia, prima fronte ambitu quasi diffluenti-effusa, pallide fulva v. demum livido-fulva; margo indistinctus; sporæ in ascis 2–3næ, circ. 40–50 μ longæ et 10–12 μ latæ, fusiformi-digitiformes, utrinque obtusæ, 13–17-loculares.—Extus fere omnino *P. fumoso-nigricantem β. fulvescentem*, Muell. Arg. in Flora, 1890, p. 188, simulat, sed thallus est subtiliter granuliger et sporæ dein sunt diversissimæ.—Ad Rio Negro prope Barra, *Spruce*, n. 454; et prope S. Gabriel, *Spruce*, n. 444.

22. LOPADIUM MEMBRANULA, *Muell. Arg.*; thallus æruginoso- v. pallido-virens, maculiformis, lævis; apothecia evoluta circ. ½ mm. lata, orbicularia, membranula simulantia, fulvo-carnea, subpellucida, unicolora, margine haud prominente subindistincto cincta et nuda; lamina undique hyalina; paraphyses valde tenellæ, haud separabiles; sporæ in ascis 2–8næ, 30–36 μ longæ, 8–12 μ latæ, elongato-obovoideæ, utrinque obtusæ, 6–8-loculares, loculi 2-locellati.—Ad *L. carneum*, Muell. Arg., accedit et similiter etiam *Tricharinæ leucotricham*, Fée, profert.—In foliis Palmarum minorum in reg. sup. Amazonum, *Trail*; et in fol. Dicotyledon. prope S. Gabriel ad Rio Negro, *Spruce*, n. 496.

Trib. CŒNOGONIEÆ.

23. CŒNOGONIUM SUBVIRESCENS, *Nyl. in Flora*, 1874, p. 72; ad Rio Negro prope San Gabriel, in acie marginis foliorum expansiones semiorbiculares formans, parcissime lectum, *Spruce*, n. 496.

24. CŒNOGONIUM INTERPLEXUM, *Nyl. in Ann. Sci. Nat.* sér. iv., xvi. p. 92; in reg. super. flum. Amazonum frequens ad varia folia sed raro fertile, *Trail*; et similiter in reg. flum. Rio Negro, ad Barra, *Spruce*, n. 615; S. Gabriel, *Spruce*, n. 491; et ad Panuré, *Spruce*, nn. 537, 582.

Trib. THELOTREMEÆ.

25. CHROODISCUS COCCINEUS, *Muell. Arg. Lich. Epiph.* n. 45.—Platygrapha coccinea, *Leight. in Trans. Linn. Soc.* xxv. p. 456.—Chroodiscus rutilus, *Muell. Arg. L. Epiph.* n. 46.—Platygrapha rutila, *Stirt. in Proc. Phil. Soc. Glasgow*, xi. p. 104.—Ambæ non differunt, in eadem lamina enium subinde occurrunt sporæ 4næ, 5næ, 6–8næ et earum magnitudo dein nonnihil ludit. Apothecia etiam subinde nonnihil astroideo-lobata observantur.—In foliis Palmarum minorum in reg. super. flum. Amazonum, *Trail*; et in regione Rio-Negrensi prope Barra, *Spruce*, nn. 548, 594, 605, 647; ad Panuré, *Spruce*, n. 535; ad S. Gabriel, *Spruce*, nn. 468, 476, 482, 499, 567; et ad Uanauaca, *Spruce*, n. 436.

Trib. GRAPHIDEÆ.

26. ARTHONIA HYMENULA, *Muell. Arg.*; thallus pallenti-albidus, maculari-tenuissimus, minutissime granularis; gonidia suboblongo-angulosa; apothecia circ. $\frac{3}{4}$ mm. lata et minora, orbicularia, membranaceo-tenuissima, madefacta magis turgidula et hyalina, sicca aquoso-pallida, ambitu fuscescenti-umbrata; asci obovoidei, late obtusi, 8-spori; sporæ 8–16 μ longæ, 3–4 μ latæ, 4–5-loculares, loculus summus in bene evolutis non major.—Habitu ad *Patellariam fumoso-nigricantem*, Muell. Arg., accedit, sed thallus subtiliter granulosus, apothecia minora et pallidiora et lamina dein Arthoniæ. Sporæ cæterum magis divisæ sunt.—*Patellaria pellicula*, Muell. Arg., quæ etiam similis, sporis multo majoribus præter alia recedit, et præsens dein ab *Arthoniopside accolente*, Muell. Arg., iterum simili, sporis multo magis divisis et præsertim systemate gonidiorum differt. Juxta *Arthoniam Antillarum*, Nyl., locanda est.—In foliis Palmarum minorum in reg. super. Amazonum, *Trail*.

27. ARTHONIOPSIS LEPTOSPERMA, *Muell. Arg. L. Epiph.* n. 43; in fol. coriaceis Dicotyledon. in reg. super. Amazonum, *Trail*.

28. ARTHONIOPSIS ACCOLENS, *Muell. Arg. L. Epiph.* p. 17.—Arthonia accolens, *Stirt. in Proc. Phil. Soc. Glasgow*, xi. p. 105; in fol. Monocotyled. in reg. sup. Amazonica, *Trail*; et secus Rio Negro prope S. Gabriel, *Spruce*, n. 493.

29. ARTHONIOPSIS CYANEA, *Muell. Arg. L. Epiph.* n. 17.—Arthonia cyanea, *Muell. Arg. in Flora*, 1881, p. 233; in foliis Monocotyled. in reg. sup. Amazonum, *Trail*.

30. ARTHONIOPSIS OBESA, *Muell. Arg.*; thallus tenuissime maculiformis, pallido-virens; gonidia primum connato-phyllactidialia, series cellularum radiantes autem demum superne discretæ; apothecia 1–1½ mm. lata, orbicularia et angulosa et irregulariter late oblonga, nigro-fusca, subplana, griseo velata v. medio demum nuda; sporæ 4–8næ, 16–17 μ longæ et 6½–7½ μ latæ, oblongo-obovoideæ, ambitu pro genere crassæ, utrinque latæ obtusæ, 4-loculares, loculus summus distincte deminutus, penultimus reliquis major.—Similis *A. palmulaceæ* sequenti, sed apothecia velata et sporarum ambitus et structura differunt.—E characteribus valde accedere videtur ad *Arthoniam suffusam*, Stirt., ubi sporæ graciliores et apothecia rotunda.—In foliis Palmarum minorum in reg. super. Amazonum, *Trail.*

31. ARTHONIOPSIS PALMULACEA, *Muell. Arg.*; simillima *A. accolenti*, Muell. Arg., sed apothecia demum paullo majora et plus minusve angulosa, et sporæ dein longe robustiores, valide digitiformes, 17–30 μ longæ et 5–8 μ latæ, e 2–3-septato mox 5-septatæ, loculus superior reliquis major. Systema gonidiale etiam primum normaliter phyllactidiale, sed series dein versus extremitatem haud raro sensim segregantur.—In foliis Palmarum minorum in reg. super. Amazonum, *Trail.*

32. ARTHOTHELIUM CANDIDUM, *Muell. Arg. in Flora*, 1890, p. 194.—Myriostigma candidum, *Krempelh. Lich. foliic.* p. 22, et *in Nuovo Giorn. Bot. Ital.* vii. p. 45.—In foliis Laurinearum (nisi fallor) et Palmarum minorum in reg. sup. Amazonum, *Trail*; nec non ad Rio Negro, *Spruce*, n. 628; prope Barra, *Spruce*, n. 599.

33. MAZOSIA ROTULA, *Muell. Arg. in Bull. Soc. Bot. Belg.* xxx. p. 77.—Rotula vulgaris v. radians, *Muell. Arg. in Flora*, 1890, p. 191, quæ primitiva Strigula rotula, *Mont. Cub.* p. 140.—In foliis Palmarum minorum et Monocotyled. aliarum in reg. sup. Amazonum, *Trail*; et secus Rio Negro prope Barra, *Spruce*, nn. 461, 593, 611; Panuré, *Spruce*, n. 578; et ad San Gabriel, *Spruce*, nn. 426, 466, 467, 491, 492.

— —, v. GRANULARIS, *Muell. Arg. in Bull. Soc. Bot. Belg.* xxx. p. 77.—Rotula vulgaris v. granularis, *Muell. Arg. in Flora*, 1890, p. 192; ad flum. Amazonum, *Trail*; et ibidum prope Iguape dos Ramos, *Spruce*, n. 511; et in reg. Rio Negro, ad Panuré, *Spruce*, nn. 531, 534; ad Maribitanus, *Spruce*, n. 641; Barra, *Spruce*, nn. 450, 452, 460, 461, 549; et demum prope San Gabriel, *Spruce*, nn. 426, 431, 478, 479, 480, 492, 493, 497, 499, 500, 504, 574.

MAZOSIA ROTULA, v. GRANULARIS, f. ATHALLINA.—Rotula vulgaris v. granularis f. athallina, *Muell. Arg. in Flora*, 1890, p. 192; haec eadem est ac plantula Paraguayensis a sub *Strigula umbilicata*, Muell. Arg. Lich. Parag. n. 214 descripta, thallo omnino destituta et juvenilis. Specimina Spruceana (et Puiggariana e Brasilia meridionali) sunt melius evoluta, thallo omnino deficiente aut minute sparso-granuloso, apotheciis magis apertis, Lichenem clare discocarpicum demonstrant, structura interiore ab ex *Mazosiæ* non diversa.—In regione Rio Negro prope S. Gabriel, *Spruce*, n. 500.

— —, v. LÆVIS, *Muell. Arg. in Hedwigia*, 1891, p. 184; in foliis Palmularum in reg. sup. Amazonum, *Trail*; ad Santarem, *Spruce*, n. 420; ad Rio Negro prope S. Gabriel, *Spruce*, n. 497; et prope Barra, *Spruce*, nn. 603, 611.

34. MAZOSIA EMERGENS, *Muell. Arg. in Bull. Soc. Bot. Belg.* xxx. p. 77; in reg. sup. Amazonum ad folia Palmarum minorum, *Trail*; et in reg. Rio Negro in variis foliis prope Barra, *Spruce*, nn. 450, 605.

35. MAZOSIA TUMIDULA, *Muell. Arg. in Bull. Soc. Bot. Belg.* xxx. p. 77.—Platygrapha tumidula, *Stirt. in Proc. Phil. Soc. Glasgow*, xi. p. 103.—In foliis Palmarum (Stirt.) et Aroidearum in reg. sup. Amazonum, *Traill*; et in reg. Rio Negro prope S. Gabriel, *Spruce*, n. 567.

36. MAZOSIA STRIGULOIDES, *Muell. Arg. Bull. Soc. Bot. Belg.* xxx. p. 77.—Platygrapha striguloides, *Krempelh. Lich. foliic.* p. 15; *in Nuovo Giorn. Bot. Ital.* vii. p. 41.—Rotula striguloides, *Muell. Arg. L. Epiph.* p. 20.—In foliis Palmarum et Aroidearum in reg. sup. Amazonum, *Trail*; ad Santarem, *Spruce*, n. 420; in reg. Rio Negro ad San Gabriel, *Spruce*, nn. 428, 443, 466, 501; ad Uanauaca, *Spruce*, n. 439; ad Panuré, *Spruce*, nn. 569, 577, 578; ad Barra, *Spruce*, nn. 445, 451, 592, 593, 607, 621.

37. AULAXINA OPEGRAPHINA, *Fée, Ess.* pp. c et xciv, t. 2. fig. 6; *Muell. Arg. in Flora*, 1890, p. 191.—Platygrapha quadrangula, *Stirt. in Proc. Phil. Soc. Glasgow*, xi. p. 103.—In foliis Palmarum minorum in reg. super. Amazonum, *Trail*; et in reg. Rio Negro, *Spruce*, n. 463; S. Gabriel, *Spruce*, nn. 458, 482, 563, 567, 570; ad Barra, *Spruce*, nn. 605, 455 (ulterior sine sporis).

Trib. STRIGULEÆ.

38. STRIGULA NIGROCINCTA, *Muell. Arg. in Hedwigia*, 1891, p. 187; ad Rio Negro prope San Gabriel, *Spruce*, n. 560.

Strigula nigrocincta, v. soluta, *Muell. Arg.*; laciniæ thalli discretæ et subdiscretæ, nec centro late in discum confluentes. Apothecia et sporæ cum specie conveniunt.—Ad Rio Negro prope Marabitanos, *Spruce*, n. 640; ad S. Gabriel, *Spruce*, n. 560; ad Barra, *Spruce*, n. 611.

39. Strigula argyronema, *Muell. Arg. in Engl. Jahrb.* vi. p. 379; in fol. Palmularum ad flum. Amazonum, *Trail*; et secus Rio Negro prope Barra, *Spruce*, n. 612; ad Casiquiaro, *Spruce*, n. 627.

— —, v. confluens, *Muell. Arg. Bull. Soc. Bot. Belg.* xxx. p. 88; San Gabriel, *Spruce*, n. 560; Penuré, *Spruce*, n. 583; ad Barra, *Spruce*, n. 612.

40. Strigula deplanata, *Muell. Arg. in Flora*, 1885, p. 341; ad Rio Negro, *Spruce*, n. 418.

41. Stigula pulchella, *Muell. Arg. in Engl. Jahrb.* vi. p. 379; ad flumen Amazonum prope Caipure, *Spruce*, n. 422 (parcissime aliis admixta).

42. Strigula Glaziovii, *Muell. Arg. in Flora*, 1890, p. 199 (hic *Cephaleuros*, Phycolog.); prope Guyaquil, *Spruce*, n. 832.

43. Strigula complanata, var. subtilis, *Muell. Arg.*; lacinulæ discretæ, tenuissimæ, circ. $\frac{10}{100}$—$\frac{15}{100}$ mm. latæ, glabræ v. supra brevissime hirtellæ (cæterum ut in tota specie subtilissime longitrorsum costulatæ). Est similis v. *ciliatæ*, Muell. Arg., sed non ciliata est. Tota visa fulvo-fuscescens, sed sterilis tantum lecta. —Ad Rio Negro prope Barra, *Spruce*, n. 456; ad S. Gabriel, *Spruce*, n. 496.

44. Strigula setacea, *Muell. Arg.*; tota usque ad centrum lacinioso-divisa, laciniæ pennatim et dendroideo-divisæ, setaceo-tenues, vix $\frac{1}{20}$ mm. latæ, semicylindricæ, supra celluloso-inæquales, non longitrorsum costulatæ, longe rigidule setaceo-ciliatæ. Apothecia ignota.—Ad *Str. complanatam* var. *ciliatam* et var. *subtilem*, Muell. Arg., accedit, sed laciniæ et earum superficies aliæ. A *Str. elegante* v. *nemathora*, Muell. Arg., recedit superficie haud lævigata, et dein ab omnibus citatis simul lacinulis longe tenuioribus sub lente capillari-setaceis.—Ad folia Melastomacearum (Miconiæ nisi fallor) prope Barra ad Rio Negro, *Spruce*, n. 456; cum præcedente, *Spruce*, n. 456.

45. STRIGULA ANTILLARUM, *Muell. Arg. in Engl. Jahrb.* vi. p. 379.—Melanophthalmum Antillarum, *Fée, Ess.* p. c, t. 2. fig. 2, et *Suppl.* p. 147, t. 43, Add. fig. 18.—Ad Rio Negro prope San Gabriel, *Spruce*, n. 440.

46. STRIGULA ELEGANS v. GENUINA, *Muell. Arg. in Engl. Jahrb.* vi. p. 380; in foliis Dicotyledon. secus Solimoes, *Trail*; ad flum. Amazonum, *Spruce*, n. 422; in reg. Rio Negro, *Spruce*, n. 621; ad Barra, *Spruce*, n. 614.

— —, v. INTERMEDIA, *Muell. Arg. in Engl. Jahrb.* vi. p. 380; in reg. Rio Negro prope Barra, *Spruce*, n. 437; prope S. Gabriel, *Spruce*, n. 441.

47. STRIGULA UNDULATA, *Muell. Arg.*; thallus orbicularis, planus, opacus et glaber, centro late continuus aut plus minusve in lacinulas radiantes solutus, lacinulæ lineares, planæ, undique crebre transversim subarcuato-plicatæ, cæterum in ipsa superficie non longitrorsum costulatæ; apothecia apice demum nudata, cæterum halone thallino obtecta (sporæ haud visæ).—Est proxima *St. planæ* sequenti, sed lacinulæ peculiariter concentrice undulatæ sunt. Analoga est insuper *Str. concentricæ*, Muell. Arg., ubi undulationes non radiatim sitæ.—Ad Rio Negro, *Spruce*, n. 472, parce.

48. STRIGULA PLANA, *Muell. Arg. in Engl. Jahrb.* vi. p. 381; ad flumen Caipuru in regione Amazonica, *Spruce*, n. 422 (parcissime tecta); in regione Rio Negro ad Panuré, *Spruce*, n. 587; ad Barra, *Spruce*, nn. 600, 613; ad San Gabriel, *Spruce*, nn. 441, 560.

49. STRIGULA SUBTILISSIMA, *Muell. Arg. in Flora*, 1883, p. 346; in regione Rio Negro, ad S. Carlos, *Spruce*, n. 623; ad S. Gabriel, *Spruce*, nn. 476, 492, 554; ad Maribitanos, *Spruce*, n. 641.

Trib. PYRENULEÆ.

50. PHYLLOBATHELIUM EPIPHYLLUM, *Muell. Arg. in Flora*, 1890, p. 195; in fol. Palmarum minorum in reg. super. flum. Amazonum, *Trail*.

51. PHYLLOPORINA EPIPHYLLA, *Muell. Arg. L. Epiphyll.* p. 21. —Porina epiphylla, *Fée, Ess. Suppl.* p. 75; in variis fol. vulgaris in reg. super. Amazonum, *Trail*; ad Rio Negro, *Spruce*, nn. 419, 618; ad San Gabriel, *Spruce*, nn. 435, 477, 482.

52. PHYLLOPORINA RUFULA, *Muell. Arg. L. Epiph.* p. 21.—Verrucaria rufula, *Krempelh. L. foliic.* p. 20.—Verrucaria rubicola, *Stirt. Lich. on Liv. Leaves*, p. 9.—In reg. Amazonica variis locis, *Trail*; prope Para, *Spruce*, n. 506.

— —, v. OBSCURATA, *Muell. Arg. in Flora*, 1890, p. 196; in reg. super. Amazonum, *Trail*; et in reg. Rio Negro ad Panuré, *Spruce*, n. 580.

53. PHYLLOPORINA RUBENTIOR, *Muell. Arg. L. Epiph.* p. 21.—Verrucaria rubentior, *Stirt. Proc. Phil. Soc. Glasgow*, xi. p. 107.—In reg. super. Amazonum, *Trail*; in reg. Rio Negro, ad San Gabriel, *Spruce*, n. 567; ad Barra, *Spruce*, n. 605; ad Panuré, *Spruce*, n 531.

54. PHYLLOPORINA OCTOMERA, *Muell. Arg. in Flora*, 1890, p. 198; in fol. Aroidearum in reg. super. Amazonum, *Trail.*

55. PHYLLOPORINA CÆRULESCENS, *Muell. Arg. in Flora*, 1890, p. 198; in regione super. Amazonum (apotheciis haud bene evolutis), *Trail.*

56. PHYLLOPORINA PLATYPODA, *Muell. Arg. L. Epiph.* p. 22; in fol. Dicotyledon. et Palmarum minorum in reg. super. Amazonum, *Trail*; et in monte Tavita regionis Rio Negro, *Spruce*, n. 631.

57. PHYLLOPORINA SPRUCEANA, *Muell. Arg.*; thallus macularis, tenuissimus, fuscescenti-virens, integer lævigatus; gonidia bene phyllactidialia; apothecia circ. $\frac{2}{10}$ mm. lata, nigra, conico-hemisphærica, subprominenter ostiolata, in apice acutiusculo libenter trigono nitida, cæterum opaca; sporæ in ascis angustis 8næ, circ. 20 μ longæ et 4 μ latæ, fusiformes, 4-loculares.—Affinis *Ph. lamprocarpæ*, Muell. Arg.; sed thallus alius et sporæ 4-loculares, et dein a Costaricensi *Ph. umbilicata*, Muell. Arg., differt thallo, ostiolo apice haud umbilicato et sporis utrinque subacuminatis.—Ad Rio Uaupès in reg. Rio Negro, *Spruce*, n. 430.

58. TRICHOTHELIUM EPIPHYLLUM, *Muell. Arg. in Engl. Jahrb.* vi. p. 418; in fol. Palmarum minorum in reg. super. Amazonum, *Trail.*

FORMATIONES LICHENOSÆ INCOMPLETÆ.

59. TRICHARIA MELANOTHRIX, *Fée, Meth.* p. 87, t. 3. f. 18, A, C; in foliis Palmarum in regione Amazonum, *Trail*; et in fol. Dicotyled. in regione Rio Negro prope S. Carlos, *Spruce*, n. 624.

60. Tricharia leucothrix, *Fée*, *Meth.* p. 87, t. 3. fig. 18, B; in variis foliis in regione Rio Negro, S. Gabriel, *Spruce*, nn. 566, 572; Barra, *Spruce*, n. 548; Panuré, *Spruce*, n. 585.

Species Haplopyrenulæ, nunc ad Fungos a me relatæ, aderant 4 sequentes a cl. Spruce in reg. Rio Negro lectæ.

61. Haplopyrenula discopoda, *Muell. Arg. in Flora*, 1883, p. 273; ad San Gabriel, *Spruce*, n. 563.

62. Haplopyrenula acervata, *Muell. Arg. Lich. Paraguay.* n. 239; ad San Gabriel, *Spruce*, n. 476; ad Barra, *Spruce*, n. 457.

63. Haplopyrenula gracilior, *Muell. Arg. in Flora*, 1883, p. 273; ad San Gabriel, *Spruce*, n. 480; ad Barra, *Spruce*, n. 446.

64. Haplopyrenula vulgaris, *Muell. Arg. in Flora*, 1883, p. 273; ad Barra, *Spruce*, nn. 445, 610; ad Panuré, *Spruce*, n. 583.

The River Thames as an Agent in Plant Dispersal. By H. B. Guppy, M.B. (Communicated by W. B. Hemsley, F.R.S., A.L.S.)

[Read 16th June, 1892.]

In this paper I propose to state briefly the results of observations as to the agency of the Thames, its tributary the Lea, and to a minor extent of the Roding, in the dispersal of plants.

Not only in autumn, but during the winter and throughout the spring, these rivers are ever carrying seeds, seed-vessels, and other vegetable drift to the sea. It might well be supposed that the autumnal floods, such as the severe floods of October 1891, would wash these rivers clear of vegetable drift, and that but little would be found in the spring. Such, however, is not the case. The months of January and February have yielded my richest collections both in this and in the preceding year in all these rivers, and the explanation of this fact is to be found in the numerous checks that occur in the progress seaward of the vegetable drift. Winds blowing from the same quarter for a week or two, at right angles to the course of the river, cause a surface-flow across the stream, by which much drift is carried

out of the current; and in this manner a considerable amount of material is often caught in the surviving patches of flags near the side or is embayed in a sheltered hollow in the bank, where it may remain for weeks or even months. In the lower parts of the Lea, between Lea Bridge and Park Lock, where the current is slow and the river divided up into numerous tortuous channels, large collections of drift are to be found in spring in some of the bends, especially after a long succession of easterly winds. Should westerly winds follow, the accumulation of weeks is carried in a few days into the centre of the river, and the drift proceeds once more down stream. Then, again, floods, when the waters subside, leave much material stranded on the banks or in their vicinity, and there it may lie for weeks or months until another flood picks it up. Amongst the lesser hindrances are the eddies, by which the drift may spend days in one locality. Here, again, the wind is an important agent either in keeping together or in dispersing the drift. This is well seen in the eddies at the weirs. When the wind blows towards the weir the descending drift scarcely collects in the eddy, but a wind blowing from the weir confines the drift in the eddy and there it accumulates. In this manner I saw a large amount of diatomaceous scum, which had been gathering some days above Moulsey Lock, carried over the weir in an hour or two. The last obstacle to the descent of the drift is by no means the least. When, to take the case of the Thames, the seeds and seed-vessels reach Teddington Weir, many of them have been probably battling their way down the river for months. On being carried over this weir they come within the influence of the tides, and there is no saying how many times they are carried to and fro in the reversing currents before they successfully pass Richmond and proceed on their way to Kew, and probably enough, when a seed-vessel arrives off Gravesend, it has actually traversed the distance below Teddington many times over.

My experience of the Thames hitherto has been from Richmond up to Sunbury Weir. By using the tow-net opposite the weirs, and collecting the drift in other places where it had become embayed or caught in the flag-patches, I have gathered in a single day materials for months of work. Picking out individual seeds or fruits or bulbs is not a method to be recommended. It is not the way to sample the drift, as most of the smaller and dark-coloured objects escape notice. The only plan

is to tow the net along in the eddies where the drift abounds; and this is often best done from the bank, or where the drift is massed together in quantity it may be ladled indiscriminately into the net. The tedious labour of picking out the seeds and seed-vessels, &c., from the rubbish has to be performed at home; but the seeds and seed-vessels are by no means the only things to look for. Many an unimportant-looking piece of a stem or branch, if it is provided with a node, will reproduce the plant, though it may be only half an inch in length. In this manner I have raised plants of *Scutellaria galericulata*, *Nasturtium* sp., from what seemed mere bits of floating rubbish, but which were really small fragments of their stems or branches. Then, again, the shoots of *Myosotis palustris* and other plants are present in numbers, with several of the shoots and buds of the Potamogetons and of *Sagittaria sagittifolia*. But there will be found much that is not botanical amongst the rubbish. The entomologist, particularly, will be interested in the large number of grub-cases that float about in our rivers all the year, and there will be found numerous other minute forms of life which are beyond the subject of this inquiry.

In my ignorance of a large number of the seeds and fruits, of the bits of stem, of the buds, and of the leaves, which in one case at least are able to reproduce the individual, I had to raise the plant. This served the double purpose of establishing the germinating power, or the reproductiveness, or at least the vitality of the seed, seed-vessel, portion of stem or branch, bud, shoot, or leaf, as the case might be, and of identifying the plant. But even after, with much labour, one has sorted out the collections, and the seed-vessels and seeds have been placed in saucers of water covered over, where they will ultimately germinate, the large basin of rubbish should be left to stand. It will convey much information, as the spring advances, of the somewhat mysterious winter history of the *Lemnæ* and other small plants that thrive on its surface. In fact, the whole method of inquiry is well suited to throw light on the winter history of many of the less familiar water-plants.

My observations on these rivers are not yet complete, but I may say that collections obtained from the drift of the Thames and the Lea have much the same composition, the differences between them being few. The seeds and seed-vessels first begin to accumulate in any quantity in October, and on through the

winter, to the months of February and March, there are to be always found floating in these rivers, usually in numbers, the carpels of *Ranunculus repens* and *Ranunculus sceleratus*; the nuts of *Lycopus europæus* and *Scutellaria galericulata*; the fruits, enclosed in the perianth, of *Atriplex patula*, *Rumex conglomeratus* and of two or three other species of *Rumex*; the mericarps of *Angelica sylvestris*; the nuts of *Alnus glutinosa* and *Betula alba*; the drupes of *Sparganium ramosum*; the carpels of *Alisma Plantago*; and the fruits of different species of *Carex*. Others less frequent, a few of which, however, are certain to be found during this period, when one collects a large amount of material, are the separate black carpels of *Galium palustre* and the seeds of *Iris Pseudacorus*. Some fruits, such as the carpels of *Sagittaria sagittifolia* and the nuts of *Potamogeton natans*, occur frequently in the drift in the autumn but become scanty as the spring comes on. The above remarks apply to both the Thames and the Lea, but it should be added that the Thames is distinguished from the Lea by the number of the seeds of *Impatiens fulva* and of the winged seeds of *Rhinanthus Crista-galli* that float through the winter to the spring; whilst *Bidens* achenes are more frequent in the Lea.

Generally speaking, all the seeds and seed-vessels in the drift of the spring have floated through the winter. This statement is not based merely on their occurrence in the drift of these rivers in the spring but also on a series of parallel experiments carried on through the winter indoors. The nuts, however, of the Alder and the Birch form exceptions to this rule. Alder nuts float for many months, but from September to June I have noticed that they are always dropping out of the cones into the water; and in fact most of the nuts found in the drift in the spring have evidently, from their fresh appearance, been only a few weeks in the water. A similar explanation applies to the Birch nuts; they only float a few days and yet occur in numbers in the drift in the months of February and March.

With the exception of the Birch nuts, all the seeds and seed-vessels above named as occurring in the river-drift in the spring germinate in the water in March and April, if not before, and in nearly every case the germination is completed at the surface. It may happen sometimes that germination is delayed till the following year. Thus seeds of *Iris Pseudacorus* germinated

whilst still afloat after a period of 14 months in the water; during the first spring, however, they were kept in a cool place but exposed to the light, and I thus prevented their germination. I scarcely think that this is at all a common event in our rivers, as floating seeds have many enemies. Coming to the liberated dicotyledonous seedlings, I may say that as a general rule they float and thrive at the surface, developing the first few leaves, but not attaining a greater length than an inch or two even after months afloat, and never of course growing into a characteristic plant; though if stranded on a mud-bank, as I proved by experiment, they very readily strike into it and develop into the full-sized plant. The behaviour of the floating monocotyledonous seedlings is much the same; in nearly all cases it is necessary, in order to develop into a plant, that they are stranded on the mud. I am now, however, trespassing beyond my limits. Space only permits me to make the scantiest of references to a matter in which probably lies the parting of the ways between land- and water-plants.

Up to this point I have said nothing of the influence of ice on river-drift. In the ice that in a severe winter covers the Lea, and forms at the margins of the Thames, seeds and seed-vessels are in certain localities inclosed in numbers. But for many reasons it is not an easy matter to find ice inclosing the drift. The indiscriminate examination of ice-blocks is perfectly useless. However, I may say that I found this winter, in the ice at the riverside opposite Hampton, numbers of the fruits of *Rumex conglomeratus*, *Lycopus europæus*, and *Alnus glutinosa*; and in the Lea ice of last year I found the fruits of *Bidens* sp., *Lycopus europæus*, *Ranunculus repens*, &c.; and I may here add that in the ice of the ponds of Epping Forest I found the fruits of *Scutellaria galericulata*, *Lycopus europæus*, *Galium palustre*, *Potamogeton natans*, *Carex* sp., &c. My experiments show that the ice of an English winter does not affect the germinating power of the seeds inclosed in our ponds and rivers. In fact, during the past winter I have had fruits of the above-named plants, together with those of *Ranunculus sceleratus*, *Atriplex patula*, *Sparganium ramosum*, *Alisma Plantago*, and *Potamogeton natans*, inclosed in ice for twenty days, and the germinating power of their seeds does not seem to be at all affected, quite as large a proportion germinating as in the case of seed-vessels not inclosed in ice. In the shallow water of the Lea I found that when the

ice was frozen to the bottom, the underlying mud was also frozen for an inch or so and came up in one continuous mass with the ice. In this manner I lifted up in the ice-slabs shoots of *Myosotis palustris*, which I have still alive. However, as there is no space in this paper for dealing with the subject of ice-transportal, I can only here remark that seeds of *Nuphar luteum* and *Nymphæa alba*, drupes of *Sparganium ramosum*, together with nuts of more than one species of *Potamogeton*, which were 12 days in frozen mud in my saucers, freely germinated.

Though ice does not affect the ultimate germination of the seeds and seed-vessels inclosed in it, it sends great numbers of them to the bottom after the thaw. The nuts of *Potamogeton natans* sink in quantities. Quite half of the fruits of *Sparganium ramosum* go to the bottom. Two-thirds of the carpels of *Ranunculus repens*, about half of the fruits of *Atriplex patula*, and many of the carpels of *Alisma Plantago* also sank. On the other hand, the seeds of *Iris Pseudacorus* and the fruits of *Rumex conglomeratus*, *Lycopus europæus*, and *Scutellaria galericulata* did not suffer much. The seeds and seed-vessels that sank after being inclosed in ice germinated freely afterwards, and in some cases the sinking evidently assisted germination. The cause of the sinking is to be found in the ice affecting the vitality of the outer coverings or buoyant portions of the fruit; a process which in the case of the fruits of *Sparganium ramosum* and *Potamogeton natans* directly aids germination. Another effect of ice is to send half the fronds of floating *Lemnæ* to the bottom, the rest surviving to the spring. It may, in fact, be generally stated that after a thaw the surface of a river is cleared of a large proportion of the floating drift. . . . When a germinating seed or seed-vessel is inclosed in ice, germination is arrested; but after the thaw, in the case of *Rumex conglomeratus*, for instance, the process is often rapidly completed and a diminutive seedling is prematurely discharged, which soon shows the first leaf and evinces other signs of vitality. If, however, germinating carpels of the two species of *Ranunculus repens* and *aquatilis* are inclosed in ice, many of them do not complete the process after the thaw, and rarely does a healthy seedling survive. The germinating carpels of *Ranunculus sceleratus* fare somewhat better. Should the seedlings of the plants above named be inclosed in ice, many of them will produce the plumule after a continuous period of 8 or 10 days in ice. In fact, some seedlings

seem to get fresh vigour in the ice, and, like those of *Ranunculus aquatilis* and *Rhinanthus Crista-galli*, will even develop the first leaf or leaves during the daily thaw, whilst locked in the ice at night.

I pass now to the consideration of those seeds and seed-vessels which reach the sea. There is scarcely one of the seeds and seed-vessels common in the drift of the Lea and the Thames that will not float for months in sea-water and afterwards germinate. Fruits of *Sparganium ramosum* germinated after as much as twelve months afloat in sea-water; and those of *Ranunculus repens*, *Ranunculus sceleratus*, *Galium palustre*, *Bidens* sp., *Lycopus europæus*, *Scutellaria galericulata*, *Mentha aquatica*, *Atriplex patula*, *Rumex conglomeratus*, *Alisma Plantago*, *Iris Pseudacorus*, &c., with different species of *Carex*, such as *C. vulpina* and *C. Pseudocyperus*, germinated after periods of flotation of from 3 to 5 months, which were the limits not of their buoyancy but merely of my experiments. Mr. Hemsley treats at length of these matters in his work on the Botany of the 'Challenger' Expedition, a volume which has been an endless source of inspiration to me in many ways, and I cannot do more than touch on the fringe of the subject here. However, I may remark that many seed-vessels that will withstand sea-water will germinate also after a prolonged immersion in water of a much greater salinity. Those of *Sparganium ramosum*, *Carex Pseudocyperus*, *Scirpus maritimus*, &c. will germinate after an immersion of months in sea-water, the density of which has been raised to 1·050 by the addition of salt. The tiny seeds of *Juncus communis* readily germinate after lying a long time in ordinary sea-water; on the other hand, the seeds of the *Lemnæ*, if those of *Lemna minor* may be taken as a sample, will only suffer a few days' flotation in sea-water.

The sinking of a seed-vessel in sea-water by no means involves the loss of the germinating-power of the seed. A fruit of *Sparganium ramosum* that sank after floating 11½ months in sea-water afterwards germinated; and most of the fruits of *Galium palustre* that sank during my sea-water experiments on that plant also germinated; and I might give other instances. Sea-water causes the sinking of fruits by affecting the vitality of the outer coverings, on which the buoyancy of fruits nearly always depends. We see this especially well in the case of the nuts of *Potamogeton natans*, which, whilst they float some months

in fresh water, sink in a week or two in sea-water. Those nuts that sank in sea-water usually germinated. In fact, I could get no other nuts to do so, the reason being that the decay of the outer covering of the nut is a necessary step to germination, because upon it depends the opening out of the valvular portion of the endocarp: a sound-looking nut does not germinate; and thus sea-water accomplishes in a week or two what may take months in fresh water to be brought about.

A word with regard to the germinating fruits that may reach the sea. Those of *Rumex* have their germination arrested, and lose by rotting the protruding portion of the radicle; but, strange to say, should they get into a freshwater estuary after a week or two at sea, the floating fruits will proceed with the germinating process, and an undersized seedling will be prematurely discharged, which soon recovers itself and develops the plumule. On the other hand, if a germinating seed of *Iris Pseudacorus* reaches the sea, the protruding portion of its radicle soon rots off, and the germination is not continued when the seed is placed again in fresh water. There are rare cases, however, where the germinating seed or seed-vessel is not much affected by sea-water, in which, in fact, the carpels of *Ranunculus sceleratus* germinate.

Floating seedlings are doubtless carried down to the sea in numbers every spring. Some, such as those of *Bidens* sp., *Nuphar luteum*, *Mentha aquatica*, and *Alisma Plantago*, are killed in a day or two and sink to the bottom. Others, like those of *Ranunculus sceleratus*, *Galium palustre*, and *Rumex conglomeratus*, may in some cases float a week or ten days and yet recover. But the recovery is very tedious. A large part of the axis rots off, and the cotyledons often die as well: yet from the mutilated remainder I have raised plants. Still there must be littoral plants that largely owe their distribution to the ability of their seedlings to float and live in the sea. The seeds of *Salicornia herbacea*, for instance, sink in sea-water even after a winter's drying. Yet they germinate freely in sea-water, and the liberated seedling rises to the surface and thrives. The same, however, cannot be said for the seedlings of *Spergularia rubra* and *Arenaria peploides*, plants which frequent, however, sandy shores, whilst *Salicornia herbacea* is found on muddy flats washed by the tide. I have touched incidentally on these plants, though the subject is foreign to this paper.

Having dealt very briefly, and of necessity very incompletely,

with the drift of these rivers, I pass on to remark on its negative character, as indicated in the absence of the seeds and seed-vessels of most of the familiar water-plants that flourish in their waters, a suggestive fact when we remember the wide distribution of these plants. In other words, we find in the drift the seed-vessels and seeds of the plants that live on the banks rather than those of the plants that live in the water. One misses, with two or three exceptions, the nuts of the Potamogetons. We find none of the seeds of the yellow and white Water-Lilies, *Nuphar luteum* and *Nymphæa alba*. Not even the nuts of the Water-Persicaria (*Polygonum amphibium*) are to be seen. Nor do the fruits of the Water-Ranunculus (*Ranunculus aquatilis*) or of the Water Forget-me-not (*Myosotis palustris*) come under our notice. Where are the fruits of *Ceratophyllum demersum* and the nuts of *Scirpus lacustris*, plants that are common enough in places in these rivers? The missing seeds and seed-vessels I find by my experiments to have little or no floating-power either in a river or in the sea: they are to be found lying in the river-mud.

I will take, first, the case of *Scirpus lacustris*. Even if the nuts are kept dry for eighteen months, they will not be able to float more than a day or two, and the terminal tufts of spikelets give no aid in transport. And yet we have here a plant that is found all over the globe. As far as I can judge at present, *Scirpus* nuts, as a rule, sink (for instance, those of *Scirpus palustris* sink like a stone); and thus they differ strikingly from the fruits of the Carices, which can often float a winter through, though owing their buoyancy entirely to the utricle. There is, however, an exception in the case of the sinking of the *Scirpus* nuts, those of *Scirpus maritimus* floating some time, a circumstance that may perhaps explain its station. However this may be, I will return to the question of *Scirpus lacustris*. It is found everywhere, and can get by water nowhere; and we are driven to find an explanation of its wide distribution in the agency of birds. Basing his conclusion on, as I infer, similar grounds, Mr. Hemsley, in his account of the Flora of the Bermudas, attributes its dispersal to birds. Wild duck probably aid in the dispersal of this plant as well as of others of the widely-spread species of *Scirpus*. As yet, I have only examined four of these birds, and three of them contained in their gizzards the nuts of *Scirpus* or of other genera of Cyperaceæ.

Scirpus nuts from two wild ducks purchased in the latter part of February have since germinated.

Next I take the instance of *Ceratophyllum demersum*. The plant flowers freely in the Lea; but I never found a mature nut, and in fact, after much disappointment in my greenhouse, I brought only a solitary fruit to maturity. The fruit sinks like a stone, and the plant is soon killed in sea-water; so that we cannot look to water for the dispersal of a plant that has established itself nearly all over the globe. Rein found it in the Bermudas, and Horne in the Fijis; and Hemsley classes its nuts with those seed-vessels that are probably transported by birds. For similar reasons, the widely spread *Polygonum amphibium* must owe its dispersal to birds; its young stems or shoots, 1–1½ inches long, are to be found floating in the Thames and the Lea in January and February; but its nuts will only be found in the mud. The fruits of *Ranunculus aquatilis* and *Myosotis palustris* cannot float very long even after drying; and for their dispersal we can look only to the transporting power of ice bearing frozen mud underneath it, or to the agency of birds. I should add that one of the most conspicuous features of the drift of the Thames and the Lea, both in the winter and in the spring, are the floating shoots of *Myosotis palustris*; they will float only two or three days in sea-water and are unable to survive.

With regard to the two Water-Lilies, I cannot help thinking that they owe their dispersal to birds. When the fruits of *Nymphæa alba* rupture, the seeds, buoyed up by tiny bubbles of air confined in their gelatinous arils, can float a day or two, but that is all. The aril decomposes, the bubbles escape, and the seed sinks. In a different fashion, when the fruits of *Nuphar luteum* open, the white carpels, with their numerous seeds, float away down the stream, and may remain at the surface a few days, when they decompose, sink, and carry the seeds to the bottom. The process of detachment of the carpels may be watched in the river Roding: as they float down the stream, they are conspicuous on account of their whiteness, and might easily attract birds. Water-fowl have been observed pecking the *Nuphar* fruits that abound on the surface of the Wanstead lakes; and I have noticed one or two of the fruits in these lakes half eaten, as if by birds. The fruits of *Nymphæa alba* being submerged do not present the same opportunities to birds; but when one bursts, a process sometimes accomplished in a few

hours, some 1600 or 1700 seeds rise to the surface, where they float in a mass which, on account of the gelatinous aril investing each seed, looks like a patch of fish-spawn. During its day or two of flotation this would doubtless often attract birds. There are many interesting matters relating to these plants, when viewed from the standpoint of their dispersal, to which I cannot here refer. However, I should remark that, curiously enough, the seeds of *Nuphar luteum*, after drying some weeks, are able to float several weeks in sea-water, though their buoyancy in fresh water is not much increased. But the seeds kept floating in sea-water have not yet germinated; and if they do, it is doubtful whether in such an experiment we are at all imitating the process Nature adopts in the dispersal of these plants.

Lastly, I come to the Potamogetons of these rivers, many of which are found all over the globe. Most of them present little or no facilities for their dispersal by sea. Take, for instance, *Potamogeton densus*. Its fruits sink at once both in fresh and salt water, and yet the plant frequents Europe, Asia, and America. The same may be said of the fruits of *Potamogeton obtusifolius*, a plant very widely distributed. The nuts of *Potamogeton perfoliatus* will not float more than a week or two in the sea, though floating often several weeks in fresh water; and yet this plant, as I learn from Bentham and Hooker's 'Handbook,' is found all over the northern hemisphere, and even in Australia. These plants, by their floating shoots and portions of their stems, disperse themselves in rivers; and from these materials found floating in the river-drift in the spring I have raised plants. But they present little or no capacities for sea transportal; we must therefore attribute their dispersal to birds.

These examples will, I think, be sufficient to illustrate my argument that for the dispersal of many of our water-plants we must look to birds; and it would seem that birds adopt a more systematic plan of stocking distant rivers and ponds with the same plants than that with which they are usually credited. This is not a strictly botanical matter, but rather a subject for ordinary observation. Giving my opinion for what it is worth, I should be inclined to consider that the seeds and fruits of many water-plants are more frequently transported in the digestive canal of a bird than in mud sticking to its feet or plumage. The *Scirpus* nuts that germinated after being taken from the gizzard of a wild duck must have been originally sifted out of the river-

or pond-mud in which the bird sought its food; and I cannot help thinking that wild ducks and their kindred, when straining the mud, must often swallow the seeds or seed-vessels of the numerous water-plants that are not represented in the Thames drift, and which, by experiment, we learn have little or no buoyancy in water. In the favourite haunts of these birds, abroad and at home, an investigator might, without much trouble, carry out this inquiry; yet in the birds sent from many parts of the world to our London markets we have by no means a limited field of research.

There are one or two miscellaneous matters concerning the Thames drift to which I will refer in concluding this paper. They are concerned rather with particular plants than with the general principles of dispersal.

Not the least interesting things that I found floating in the Thames in March were a few buds of *Hydrocharis Morsus-ranæ* from which I am now raising plants; and I will take this opportunity of giving in a very few words the results of numerous observations and experiments on a plant to which I was especially attracted by reason of its wide distribution. It is, I think, well known that in this climate it propagates itself rather by buds than by seeds. I had great difficulty in getting any seeds from plants in my greenhouse, or in the lakes and ponds of Epping Forest, and none have yet germinated. Many of these buds float through the winter from the autumn to the spring, when they expand or, to put it more accurately, throw down their leaves and develop into the characteristic plant. I have now plants growing from buds I have kept floating from the autumn to the spring, plants growing from buds found floating in the Wanstead lakes in the middle of December and in the Thames in March, plants growing from buds that were inclosed some weeks in ice, and plants growing from buds that sank after floating a week or ten days in sea-water, which is the limit of their flotation in the sea. Thinking these hardy little buds were capable of a great deal more, I tried the effects of some months of drying; but as yet they have failed to respond. It is scarcely likely, however, that the plant was introduced into this country as a bud. The seeds sink in fresh water and sea-water; but one could hardly regard them as able to withstand a bird's digestion. When the fruit bursts, the gelatinous pulp containing the seeds is discharged, part of which sinks slowly whilst some of it adheres

to the outside of the fruit. This material would be very likely to adhere to the plumage of a bird sitting in the water, and on its drying the seeds in it would be firmly attached to the feathers.

Floating in numbers in the drift of the Thames and the Lea and of the ponds of Epping Forest from the autumn on through the winter to the spring occur the detached leaflets of *Cardamine hirsuta*. I have kept some afloat the winter through, and have obtained plants from them in the spring. I have plants grown from leaflets found floating in the Lea in February, and am now growing plants from leaflets found floating in the Thames in January and February, and also plants from leaflets that have been some weeks in ice. A week in sea-water destroys the reproductive power of the leaflet; nor do they seem to withstand drying, for the wind might be a very important agent in transporting the dried-up leaflet; but my experiments on this matter are not yet complete, and my notes on this plant have not yet been put into shape in consequence.

Lastly, I come to the *Lemnæ*, as characteristic of our rivers as of our ponds and ditches. In botanical textbooks reference is made to the disappearance or sinking of the fronds in autumn. *Lemna minor* fronds collected in the Lea in October remained at the surface through the winter, and are now thriving. I found the fronds during every month of the year, either in a river or in a pond or ditch. Sometimes I have found them in quantity inclosed in ice, as in the ponds of Epping Forest in the middle of December. Seeds that I found floating in February in the river Lea and in an Edmonton ditch germinated in March and reproduced the plant. The seeds will germinate after floating a day or two in sea-water, but a week's immersion kills them. Sea-water kills most of the fronds, even after a day's flotation; but some recover, and in one or two rare instances survived a week in the sea. The fronds do not survive twenty-four hours' drying in fine weather, whether in the sun or in the shade; but in rainy weather they can withstand an exposure of one or two days, and might thus be carried a few hundred miles entangled by their rootlets in a bird's plumage. *Lemna gibba* apparently disappears in the winter, a few dead fronds only coming under my notice. *Lemna polyrrhiza* is represented in the winter by small single rootless fronds quite different in appearance from the characteristic fronds of the spring and summer.

I found them floating in the Lea and the Thames in January, &c. *Lemna trisulca* seems to live through the winter in the Lea and Thames. After many weeks of frost in the winter of 1890–91, I found it in January inclosed in quantity in the ice of an Epping Forest pond. The fronds of *L. gibba*, *polyrrhiza*, and *trisulca* behave like those of *L. minor* both in sea-water and when dried.

A Monograph of the Genus *Dianthus*, Linn.

By F. N. Williams, F.L.S.

[Read 4th February, 1892.]

Most of the species of *Dianthus* are perennial; a few are annual, or even biennial. The cæspitose habit of many of the perennial species is due to the development of dense and leafy barren shoots, in which the internodes are almost suppressed. The rootstock produces barren shoots and ascending flowering stems. The stems are either terete or angular, *i. e.*, they may assume a cylindrical or prismatic form; in the latter case the number of the angles bears a definite relation to the phyllotaxis. As the leaves are opposite and decussate, stems that are not cylindrical have four angles, and the acuteness of the angles determines the furrowed condition of the surface. Angular stems are more frequently than not glabrous. Throughout the genus the nodes are well-developed, and such as to give the stem and its branches a jointed appearance; this is the more marked from the fact that the lamina springs direct from the stem without any intervening petiole. The internodes, which are almost suppressed in the barren shoots, in the flowering stems seem to bear some sort of relation to the leaves borne upon them, being sometimes equal in length to the leaves, sometimes double the length, and the ratio seems to obtain to the apex of the stem, where both internodes and leaves become shorter. Examples of shortened internodes are seen in the rosette of leaves at the base of the stem of *D. Caryophyllus*, in the fascicled leaves of the barren shoots of *D. plumarius*, and generically in the squamiform leaves beneath the floral organs. In the flowering stems of *D. longicaulis* the nodes are very distant. Since the intercalary growth is at its maximum, and persists longest at the base of each, in *Dianthus*

similarly as it does in Grasses, it is at this point in the vicinity of the lower node of each internode that is found localized heliotropic flexion. Positive heliotropism is, however, very feebly expressed. It is rarely that the stems spring as absolutely simple from the crown of the rootstock. They may affect a simplicity by a bifurcation deep in the cæspitose shoots at their origin, or by producing two divergent flowers at their termination. It may be difficult to determine to what extent their divergence from the crown of the rootstock is distinct, and how far the terminal flower-cluster may be reduced to a few flowers on a stem. The characteristic mode of branching is cymose, frequently in dichotomies. Sometimes, as in *D. callizonus*, the simple unbranched stem terminates in a solitary flower.

Leaves.—The two leaves of each whorl are opposite. The successive whorls of two leaves alternate so as to produce the decussate phyllotaxis. In *Syringa* and *Sambucus* the leaves are similarly arranged. It is the most frequent of alternate whorls of two leaves, but in *Rhamnus catharticus* the two leaves of each whorl are usually at a slightly different level. The mature leaf is symmetrical, though in the aciculate leaves of a few species, such as *D. pinifolius*, this is not always patent: it is sometimes, as in *D. barbatus*, contorted at the base. The midrib is usually strong, and determines, by its position in the mesophyll and its relative size to that of the leaf, the character of the laminal surface, whether plane, carinate, or canaliculate. If it is situated nearer the inferior surface of the lamina, the leaf may be both carinate and canaliculate, or it may be carinate and plane, according to the thickness; but a leaf that is canaliculate on the superior surface is never plane on the inferior. The leaves are connate at the base, and frequently contracted at that point, resembling in this respect those of *Lonicera*. The form of the mature leaf is linear and grass-like; those of the barren shoots are generally longer and broader than those of the flowering stems. The apex is more or less acute or acuminate, sometimes pungent, more rarely obtuse. The margin is entire, but is not sharp as in that of the leaf of grasses, and is often ciliolate or scabrous. The leaves of some species are of firmer texture than others, occasionally almost crassulaceous. The glaucescence characteristic of so many species temporarily disappears on pressure of the leaf between the moist fingers. The cataphyllary leaf is represented in the well-marked leaf-sheath. This last partakes

of the triplasic character of stipule, petiole, and scale. The uppermost leaves, distinct from the calyx, by some authors called bracts, are but squamiform modifications of the true foliage-leaves. The true hypsophyllary leaves occur immediately beneath the floral organs, where they form an epicalyx of bracteiform scales, generally in two pairs.

Bracts.—These organs, above referred to, are very variable in form, texture, colour, and number. The number is not always constant in the same species, and where there are three pairs, the inferior pair are always longer and narrower than the other two pairs, thus approximating in form the uppermost leaves. The study of the bracts themselves as a link in the continuity of the nutritive and reproductive organs exhibits remarkable relations. Growing close under the perianth, they form part of the flower; they resemble the leaves in their decussate arrangement, and the petals in their general contour. In their colour and texture they exhibit also transitional characters: sometimes herbaceous, like the foliage-leaves, sometimes stramineous or coriaceous, sometimes tinted purple or red, like the petals and calyx-teeth. They are generally four in number to each flower, but vary from two to sixteen; when there is but a single pair, they rather approximate in form the foliage-leaves. It also appears that one of their functions is to protect the delicate tissue of the calyx from perforation by insects attempting to reach the nectar from below, instead of approaching from above the flower, and by this means brushing the anthers and fertilizing the ovary. Bracts with mucronate points are generally closely applied to the tube of the calyx, whilst those forms with acuminate points are usually patent. The length of the bract is determined rather from its aristate prolongation than from the length of the lamina. How closely the differentiation of the appendages of the essential reproductive organs is related to the form and variation of the nutritive organs, is seen in those cases where groups of organs or of their appendages are transformed into those of next higher or lower type under changed conditions of environment. They may inclose but $\frac{1}{5}$ of the tube of the calyx as in *D. subacaulis*, or they may extend beyond it as in *D. glacialis*. They may be small rounded scales as in *D. Caryophyllus*, or slender awn-like appendages as in *D. atomarius* var. *setisquameus*.

The Flower.—The morphology of the entire plant, and particularly of the flower, is that most favourable to entomophilous

cross-fertilization. For in typical forms the barren shoots springing from the crown of the rootstock are short and decumbent, and thus expose the ascending and conspicuous flowering stems. And these are simple and paucifloral, or slightly branched, thus distributing the inflorescence over a proportionally wider area. The flowers are always terminal, and consequently not concealed by the dense barren shoots. The flowers are for the most part specious: when solitary, they are large and conspicuous; when small, they are collected into dense fascicles. The general coloration of the flower, and the frequent variegation of the lamina of the petal, is an inducement to the most fastidious of hymenopterous visitors, associated as it often is with the most fragrant perfume and easy accessibility. In the solitary or geminate flowers of *Caryophyllastrum*, the petals are repand, large and specious, slightly excavated, and well supported on the cup of the strongly-nerved calyx; in the fasciculate inflorescence of *Carthusianastrum* and the capitular inflorescence of *Proliferastrum* their close apposition gives mutual support and a large variegated area. The stamens and petals spring from an annular ridge of the torus encircling the gynophore, which latter is in the form of a prolonged axis between the calyx and the corolla. This ridge bears on its inner border a yellow fleshy cushion, which is the nectary, and in its glands there is secreted the sweet fluid which attracts the fertilizing insects.

Perianth.—This consists of three parts: (1) the imbricated bracts; (2) the gamosepalous calyx; (3) the corolla of five distinct petals. The metamorphosis of the floral organs is well shown in the production of double flowers by cultivation. These double flowers in the carnations and pinks are produced by the assumption of a petaloid appearance by other organs. Not always, however, are the supernumerary petals either reverted stamens, or carpels, or petaloid sepals, but are instances of abnormal pleiotaxy, without reversion of essential organs to flower-leaves. The teratological tendency of cultivated forms is towards petalody. The prolongation of the torus into a stipitiform gynophore seems to be analogous to the internode between the two successive whorls of the foliage-leaves, and in this case separates the whorl of the calycine from the whorl of the corollary leaves.

Calyx.—The calyx is cylindrical, sometimes contracted above, often brown or purplish at the base. The teeth are acute, acumi-

nate or mucronate, and either ciliolate, smooth, or membranous at the edges. The whole of the tube of the calyx is multistriate, and the nerves are well-marked and parallel, of which there are 7, 9, or 11 (3 in *Proliferastrum*) to each lobe. The fasciculus of nerves to each lobe is bounded by a membranous part marking the division into sepals. When the stems are pubescent the calyx is usually more so. In very rare instances, as in *D. Cyri*, it is covered with small warts, and the striation is obscure.

Petals.—Each of the two parts of the petal is quite distinct, and this constitutes really the only generic character which separates *Dianthus* from *Tunica*. The claw is very pale; the blade is bright-coloured, but frequently paler on the under surface. Chorisis in the petals is reduced to its simplest form, viz., a capillary outgrowth at the junction of the blade with the claw, and is the homologue of the corona in *Silene* and the ligula in *Lychnis*. This bearded condition of the petals serves to distinguish groups of species. The segmentation of the blade to such an extent as is seen in the fimbriate species is very unusual in flowers; and the retuse margin in *D. glumaceus* is the least specialized modification of the laminar margin. In the same species petals may be entire and dentate, but they are never entire and fimbriate or dentate and fimbriate. As to the degree of incision of the petals which should place a plant among the fimbriate species, I think no sharp line can be drawn. They should certainly include those whose petals are incised halfway or more from the margin to the throat, probably also all those with the blade incised to one-third of its depth. In those that are not so deeply incised we have to consider the relative length and breadth of the teeth or fimbriæ themselves, apart from the undissected intermediate area and the degree of their acumination.

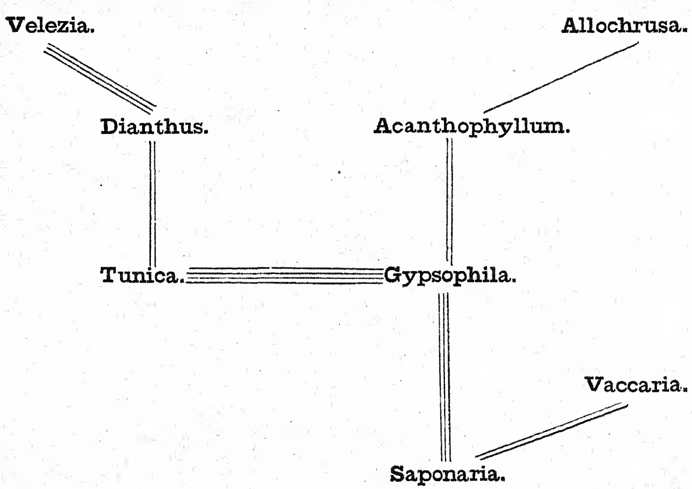
Stamens.— The dichogamous development of the essential organs is usual throughout the genus. In the individual flowers of the same plant the reproductive organs are almost invariably proterandrous, but this proterandry takes place at different times in the different flowers of the same plant; this is well seen in *D. deltoides* and *D. liburnicus*. This dichogamous mode of development undergoes a certain modification to serve similar purposes in *D. Armeria* and other species. Though proterandrous functional activity is the form of dichogamy which generally obtains, it is not so well marked in this plant; consequently that modification obtains which is adapted in other cases to intercrossing

among hermaphrodite flowers, in which synanthesis is the rule; and we find dimorphic flowers. The petals are grooved by the respective filaments of the five outer stamens. The colour of the anthers is variable.

Ovary.—This organ is unilocular, with remains of apparent dissepiments. The two styles are free at the base, pale and slender, and curve outwards in opposite directions, frequently forming a beautiful double (helicoid) curve outwards and downwards. In synanthetic specimens and cultivated forms which accidentally produce female flowers, frequently the styles are curiously contorted, crossing each other and standing nearly upright, and larger than those of the proterandrous flowers. The dehiscence of the capsule bears a more definite relation to the number of the styles and the phyllotaxis than to the subdivisions in the whorls of the other reproductive organs.

Seeds.—The seeds are peltate or orbiculate, convex above, and either plane or somewhat concave below; attached by the inner surface (not by the margin) to funicles which separately spring from the columnar placenta. The curved funicles have their slight convexity turned outwards, so that the seeds are directed downwards. The embryo is straight, and is usually situated excentrically in the albumen.

The affinity of *Dianthus* with allied genera is shown in the annexed diagram, in which the degree of divergence, one genus from another, is indicated by the greater number of connecting lines.



DIANTHUS, *Linn.**

Calyx tubulosus, 5-dentatus, tenuiter et æqualiter multistriatus, nervis parallelis ad quodque sepalum 7, 9, vel 11 (3 in *Proliferastro*) parte membranaceâ inter 5 nervorum fasciculos; bracteis (*i. e.* squamis calycinis) per paria calycem involucratim cingentibus, paribus sæpius inæqualibus. Petala 5; lamina abrupte attenuata sæpius in unguem elongatum, integra multidentata vel fimbriata, rarissime retusa, elegantia sæpe maculata. Stamina 10. Torus sæpius in gynophorum stipitiforme plus minus elongatus. Ovarium uniloculare; styli 2, a basi distincte. Capsula cylindrica oblonga vel rarius ovoidea apice dentibus valvisve quatuor dehiscens. Semina discoidea vel orbiculata, supra convexa, infra plane compressa concavave parum, ad medium faciei interioris planæ vel concavæ umbilicata; in placentâ columnari imbricata. Embryo rectus, in albumine sæpius excentricus.

Herbæ perennes nonnunquam annuæ, rarius suffruticosæ, ramis articulatis, teretibus vel tetragonis, ad nodos tumescentibus. Folia exstipulata, angusta, vulgo graminea, supremis subulatis, sæpe glauca, margine scabra. Inflorescentia terminalis; flores solitarii cymoso-paniculati fasciculati vel aggregato-capitati, vulgo rosei purpureive, nunc rubri, rare albi, nunquam lutei.

Subgenus I. CARTHUSIANASTRUM (p. 358).

Caudex annuus v. perennis; perennibus turiones decumbentes steriles emittens atque caules adscendentes floriferos. Folia subfloralia herbacea, subherbacea, v. omnino scariosa. Inflorescentia cymoso-paniculata, v. fasciculis dichotomis v. capitulis aggregatis; in suffruticosis interdum floribus solitariis. Calyx subcylindricus. Petala semper dentata. Torus parum elongatus.

Sectio i. ARMERIUM (p. 359).

Herbæ annuæ. Caules teretes. Folia subfloralia herbacea. Bracteæ 2. Calyx dentibus 9–11-nerviis. Petala barbulata.

D. Armeria, pseudarmeria, corymbosus, tenuiflorus, glutinosus.

Sectio ii. SUFFRUTICOSI (p. 361).

Perennes suffruticosi. Folia subfloralia herbacea. Inflorescentia non densa; flores cymis paniculatis v. fasciculis dichotomis, v. solitarii. Petala barbulata.

* In the following enumeration, only the more important synonyms have been cited under each species, the remainder being incorporated in the index, pp. 470–478.

Subsectio 1. *Tubulosi* (p. 361).

Calyce apice non attenuato.

* Folia non acerosa. Bracteæ 8–16.

D. arboreus, fruticosus, pendulus, actinopetalus, Bisignani, virgatus, Bertolonii.

** Caules 1–2-flori. Folia non acerosa. Bracteæ 4–6.

D. elegans.

*** Rami floriferi 1–2-flori. Folia acerosa, pungentia. Bracteæ 4–6.

D. juniperinus, aciphyllus, rigidus.

Subsectio 2. *Contracti* (p. 364).

Calyce apice attenuato.

D. Friwaldskyanus, gracilis, biflorus, Mercurii.

Sectio iii. CARTHUSIANUM (p. 365).

Herbæ perennes. Folia subfloralia scariosa, rarissime herbacea. Inflorescentia densa, capitata. Petala nonnunquam imberbia.

Subsectio 1. *Microlepides* (p. 366).

Caules teretes. Folia subfloralia scariosa. Bracteæ lanceolatæ. Calyx dentibus lanceolatis acuminatis v. acutis.

* Bracteæ herbaceæ. Petala imberbia.

D. trifasciculatus.

** Bracteæ scariosæ. Petala imberbia.

D. nardiformis, liburnicus, tymphresteus.

*** Bracteæ scariosæ. Petala barbulata.

D. transsilvanicus, heptaneurus, viscidus, japonicus, Muschianus, pinifolius, cibrarius, calocephalus, giganteus, banaticus.

Subsectio 2. *Carthusianoides* (p. 371).

Folia stricta, subfloralia scariosa. Bracteæ siccæ. Calyx dentibus lanceolatis, acuminatis acutis v. rarius mucronatis. Petala obovato-cuneata, barbulata.

* Dentes calycis acuminati v. acuti.

D. Carthusianorum, Knappii, ambiguus, Schlosseri, slavonicus, pelviformis, cruentus, Lydus, lilacinus, barbatus, subbarbatus, diutinus, Borbasii, capitatus.

** Dentes calycis mucronati.

D. intermedius.

Subsectio 3. *Macrolepides* (p. 385).

Bracteæ 4, ovatæ patentes.

* Involucri phylla scariosa, rarius herbacea. Petala barbulata.

D. compactus, crassipes, Girardini, asperulus, collinus, hymenolepis polymorphus, glabriusculus, pseudobarbatus, toletanus, tristis.

** Involucri phylla et bracteæ scariosa. Petala imberbia.

D. cinnabarinus, stenopetalus.

*** Involucri phylla herbacea. Calyx verruculosus. Petala barbulata.

D. bitlisianus.

Subgenus II. CARYOPHYLLASTRUM (p. 390).

Caudex perennis, herbaceus, breves turiones steriles decumbentes, numerososque foliososque, atque caules floriferos adscendentes, emittens. Folia subfloralia vere bracteiformia nulla, interdum 2 summis herbaceis abbreviatis nunquam subscariosis. Flores in caule ramulisve solitarii, vel geminati vel rarius terni longissime pedunculati. Calyx cylindricus valde striatus. Petala dentata integra vel fimbriata, rarissime retusa. Torus elongatus in gynophorum stipitiforme.

Sectio i. FIMBRIATUM (p. 390).

Bracteæ 4–16. Petala fimbriata.

Subsectio 1. *Plumarioides* (p. 390).

Caules teretes. Calycis dentes mucronati. Petala barbulata, non contigua.

D. plumarius, arenarius, Oreadum.

Subsectio 2. *Schistostolon* (p. 392).

Caules ramosi, glabri. Calycis dentes acuminati.

* Caules teretes. Folia 3–5-nervia. Bracteæ acuminatæ adpressæ scarioso-alatæ. Calycis dentes lanceolati.

D. monspessulanus, marsicus, squarrosus.

** Caules tetragoni. Folia 3–5-nervia. Bracteæ mucronatæ adpressæ. Calycis dentes lanceolati.

D. controversus, Sternbergii, acicularis.

*** Caules teretes. Flores subfasciculati. Bracteæ mucronatæ, albo-marginatæ. Calycis dentes albo-marginati.

D. floribundus, robustus, stramineus.

**** Caules teretes. Folia 5–7-nervia acuminata. Bracteæ 4–6. Calycis dentes 9-nervii.

D. liliodorus, Waldsteinii, Zeyheri.

***** Caules teretes. Folia 9–11-nervia acuminata. Bracteæ 2–6 adpressæ.

D. purpureus, mecistocalyx, moviensis, Kuschakewiczi.

****** Non glauci. Caules tetragoni. Folia 1–7-nervia. Bracteæ 4–8. Calycis dentes lanceolati. Petala non contigua.

D. serrulatus, tabrisianus, plumosus, valentinus.

******* Caules teretes. Folia 1–3-nervia. Bracteæ scarioso-alatæ. Calyx apice non attenuato, dentibus lanceolatis.

D. prostratus, Hoeltzeri, sinaicus, polylepis.

Subsectio 3. *Cycaxostolon* (p. 400).

Caules simplices teretes. Calycis dentes acuminati.

* Bracteæ mucronatæ. Lamina imberbis.

D. graminifolius, erythrocoleus, Noëanus, petræus, Serpæ, gallicus, macranthus, basianicus.

** Bracteæ acuminatæ. Lamina imberbis.

D. sessiliflorus, atomarius.

*** Calycis dentes lanceolati acuminati 7-nervii. Lamina barbulata.

D. fallens, fimbriatus.

Subsectio 4. *Gonaxostolon* (p. 407).

Caules simplices, tetragoni. Calycis dentes acuminati.

* Cæspitosi. Bracteæ sensim acuminatæ.

D. micropetalus, tener.

** Cæspitosi. Bracteæ abrupte mucronatæ.

D. prævertens, serotinus, canescens, crinitus, Engleri.

Subsectio 5. *Monerestolon* (p. 410).

Caulis unicus, ramosus in multos cauliculos glabros. Folia patentia recurva. Calycis dentes acuminati. Petala non contigua, lamina barbulata.

D. Libanotis, superbus, Wimmeri.

Sectio ii. Barbulatum (p. 412).

Flores solitarii vel in ramulis laxe cymosi. Petala dentata, barbulata, rosea purpureave, rarissime alba.

Subsectio 1. *Lepidacribia* (p. 412).

Bracteæ scariosæ, attingentes $\frac{1}{4}$–$\frac{1}{3}$ calycis longitudinem, adpressæ.

* Bracteæ 4–8. Calyx non verruculosus.

D. lusitanicus, lusitanoides, cæspitosus, cæsius, Colensoi, zonatus, microchelus, maris, Szowitzianus, puberulus.

** Bracteæ 2.

D. viridescens, microlepis.

*** Bracteæ 4. Calyx verruculosus.

D. polycladus, multipunctatus.

**** Bracteæ 10-14.

D. axilliflorus.

Subsectio 2. *Hemisyrhix* (p. 418).

Bracteæ 2-10, attingentes ½ calycis longitudinem.

* Folia patentia, vagina folii diam. æquante, radicalia obtusa.

D. deltoides, alpinus, brevicaulis, diffusus, myrtinervius, Buergeri, nitidus, Seidlitzii.

** Folia adpressa obtusa, vagina folii diam. æquante.

D. multisquamatus.

*** Folia adpressa acuta. Calyx verruculosus.

D. gaditanus.

**** Folia patentia acuta. Bracteæ mucronatæ.

D. pubescens, masmenæus, versicolor, elatus.

***** Folia omnia acuta v. acuminata, patentia. Bracteæ acuminatæ.

D. hypochloros, aridus, campestris, aristatus, humilis, callizonus.

Subsectio 3. *Longisquamea* (p. 427).

Bracteæ subfoliaceæ, attingentes basin dentium calycis vel calycem superantes, patentes.

D. pruinosus, pratensis, suaveolens, gelidus, glacialis, sinensis, erinaceus.

Sectio iii. Caryophyllum (p. 432).

Caules glabri. Bracteæ adpressæ. Calyx dentibus lanceolatis. Petala dentata, imberbia. Capsula ovoidea v. oblonga, nunquam cylindrica.

Subsectio 1. *Caryophylloides* (p. 432).

Folia patentia. Calyx dentibus acuminatis. Capsula ovoidea.

D. Caryophyllus, caryophylloides, longicaulis, Boissieri, multinervis, Arrostii, Falconeri, crenatus, subacaulis.

Subsectio 2. *Sylvestres* (p. 435).

Caules tenues. Bracteæ mucronatæ. Capsula oblonga.

* Bracteæ scariosæ. Calyx striatus.

D. sylvestris, laricifolius, serratifolius, Balansæ, xylorrhizus.

** Bracteæ scariosæ. Calyx verruculosus.

D. papillosus.

*** Bracteæ scarioso-alatæ. Calyx striatus.

D. attenuatus, Sabuletorum, furcatus, Nelsoni, cachemiricus, longiglumis, Jacquemontii, pachypetalus.

Sectio iv. IMPARJUGUM (p. 442).

Bracteæ nunquam 4. Petala dentata v. integra, imberbia. Capsula cylindrica.

Subsectio 1. *Platylepides* (p. 442).

Bracteæ latæ mucronatæ.

* Bracteæ scariosæ. Calyx verruculosus.

D. sulcatus.

** Bracteæ scarioso-alatæ. Calyx striatus.

D. syriacus, Gasparinii, ciliatus, aragonensis, multiceps, legionensis, virgineus.

Subsectio 2. *Stenolepides* (p. 445).

Bracteæ angustæ acuminatæ.

* Bracteæ 2, scariosæ.

D. repens.

** Bracteæ 6–10, scarioso-alatæ.

D. siculus, Kremeri, stenocephalus, fragrans, holopetalus, angolensis.

Sectio v. TETRALEPIDES LEIOPETALA (p. 448).

Bracteæ semper 4. Petala integra v. dentata, imberbia. Capsula cylindrica.

Subsectio 1. *Hispanioides* (p. 448).

Caules ramosi. Folia caulina adpressa, vagina folii diam. æquante. Bracteæ atting. $\frac{1}{3}$ calycis tubum.

* Petala non contigua.

D. hispanicus, hirtus, Requienii, albens.

** Calyx verruculosus. Petala contigua.

D. tripunctatus.

Subsectio 2. *Sætabenses* (p. 450).

Caules ramosi. Folii vagina diam. ejusdem æquante. Bracteæ atting. $\frac{1}{2}$–$\frac{2}{3}$ calycis tubum.

* Bracteæ mucronatæ adpressæ.

D. kamisbergensis, Andersonii, Sætabensis.

** Bracteæ acuminatæ patentes.

D. Planellæ, auraniticus.

Subsectio 3. *Cintrani* (p. 452).

Caules simplices. Bracteæ mucronatæ.

* Caules teretes. Bracteæ scarioso-marginatæ.

D. elongatus, micranthus, Haussknechtii, cintranus, algetamus, Langeanus.

** Caules 4-angulares. Bracteæ scarioso-marginatæ.
D. strictus, brachyanthus, insignitus.

*** Bracteæ stramineæ.
D. cognobilis, procumbens, leucophæus, anatolicus, Kotschyanus.

Subsectio 4. *Pungentes* (p. 457).

Caules simplices. Bracteæ acuminatæ.

* Folia patentia, 3-7-nervia. Bracteæ scarioso-marginatæ.
D. graniticus, serratus, acuminatus, sphacioticus, benearnensis.

** Folia caulina adpressa 3-7-nervia. Bracteæ scarioso-marginatæ.
D. anticarius, pungens, leptoloma, lactiflorus, Bornmuelleri.

*** Folia caulina patentia uninervia. Bracteæ scarioso-marginatæ.
D. judaicus, Liboschitzianus, integerrimus.

Subsectio 5. *Gymnocalyx* (p. 462).

Caules ramosi. Bracteæ minutæ scariosæ adpressæ, aristâ incurrente calycis tubum.
D. cinnamomeus, leptopetalus, rhodopeus.

Subgenus III. PROLIFERASTRUM (p. 463).

Herbæ annuæ. Folia bracteiformia (suprema) sub floribus densa submembranacea. Flores capitati. Bracteæ 2-4. Calyx 15-costatus, superne pentagono-attenuatus. Petala retusa. Torus parvus. Capsula oblonga vel ellipsoidea.

* Bracteæ acuminatæ. Calyx verruculosus, dentibus acuminatis. Semina lævia.
D. Cyri.

** Bracteæ mucronatæ. Calyx striatus, dentibus obtusis. Semina non lævia.
D. Nicolai, glumaceus, obcordatus, prolifer, velutinus.

Subgenus I. CARTHUSIANASTRUM.

Caudex annuus v. perennis; perennibus turiones decumbentes steriles emittens atque caules adscendentes floriferos. Folia subfloralia herbacea, subherbacea, v. omnino scariosa. Inflorescentia cymoso-paniculata, v. fasciculis dichotomis v. capitulis aggregatis; in suffruticosis interdum floribus solitariis. Calyx subcylindricus. Petala semper dentata. Torus parum elongatus.

Sectio i. Armerium.

Herbæ annuæ. Caules teretes. Folia subfloralia herbacea. Bracteæ 2. Calyx dentibus 9–11-nerviis. Petala barbulata.

1. D. Armeria, *Linn. Sp. Plant.* ed. 1, p. 410; *Syme, Engl. Bot.* ed. 3, ii. p. 45, t. 191; *Reichb. Ic. fl. Germ. Helv.* 5011.

Tomentosus. Caules 40 centim.*, subsimplices aut superne parce et dichotome ramosi. Folia plana stricta 5-nervia, infima 48 mm. * lineari-lanceolata obtusa, superiora 72 mm. * elongato-linearia acuta, subfloralia flores æquantia v. superantia acuminata, vagina folii diam. æquante. Inflorescentia fasciculis obliquis dichotomis 3–8 florum inodororum. Bracteæ lineari-lanceolatæ acuminatæ ad calycis apices. Calyx valde striatus, dentibus lanceolatis acutis. Petala non contigua; lamina oblongo-elliptica purpurea maculata, $=\frac{1}{3}$ unguis. Capsula subcylindrica. Semina tuberculata.

b. subhirsutus, *Schur, Enum. Pl. Transsilvaniæ*, p. 91.

Plus minus hirsutus. Flores magni, laminis pallide purpureis.

c. Armeriastrum, *Wolfn.* (sp.) *in Oesterr. Bot. Zeitsch.* 1858, p. 318.

Bracteæ obovato-subulatæ. Calyx dentibus rubescentibus. Lamina speciosa.

d. pseudarmeria, *Wierzb.* (sp.) *Schur, Enum. Pl. Transsilvaniæ*, p. 91.

Sub apice pubescens, ceterum glaber. Flores minimi atropurpurei.

e. subacaulis, *Schur, Enum. Pl. Transsilvaniæ*, p. 92.

Caulis abbreviatus. Flores longissime pedunculati magni, pedunculis hirsutis.

f. glaber, *Vandas, in Oesterr. Bot. Zeitsch.* 1888, p. 333.

Glabriusculus.

g. cæspitosus, *Clav. Flore de la Gironde*, p. 156 (1882).

Geogr. limits.—*N.* Gothland, 56°. *E.* Talysch, 49°.
S. Sicily, 38°. *W.* Asturias, 8°.

2. D. pseudarmeria, *Bieb. Fl. Taur. Cauc.* i. p. 323; *Boiss. Fl. Orient.* i. p. 508; *Reichb. Ic. Pl. crit.* 737.

Pilosus. Caules 25 centim., parce ramosi. Folia 40 mm., linearia acuta 5-nervia stricta adpressa, vagina folii diam. æquante. Inflorescentia in corymbum sæpius compositum 12–15

* The measurements given throughout are those of good average specimens.

florum dense congesta. Bracteæ lanceolato-ovatæ acuminatæ ad calycis apices, squarroso-patentes. Calyx dentibus lanceolatis acuminatis. Petala non contigua; lamina obovato-cuneata rosea. Antheræ purpureæ. Semina orbicularia granulata.

Geogr. limits.—*N.* Prov. of Don Cossacks, 47°.
S. Erzeroum, 40°.
E. Georgia, 47°.
W. E. Rumelia, 25°.

3. D. CORYMBOSUS, *Sibth. Fl. Græca*, iv. p. 85, t. 395; *Boiss. Fl. Orient.* i. p. 508.

Breviter pubescens. Caules 62 centim., multiflori in ramos corymbosos divaricatos dividentes. Folia 42 mm., linearia acuta recurva 3-nervia, vagina folii diam. æquante. Inflorescentia capitulis 3–4 florum. Bracteæ ovales patentes subulato-aristatæ ad dimidium calycem. Calyx apice attenuato, dentibus lanceolatis acuminatis. Petala contigua; lamina obovato-cuneata maculata purpurea subtus flavida. Antheræ cæruleæ. Capsula subclavata dentibus obtusis.

b. Poiretianus, *Ser.* (sp.) *in DC. Prodr.* i. p. 360.

Bracteæ ovato-ellipticæ adpressæ, apicem versus purpurascentes.

Geogr. limits.—*N.* Bessarabia, 47°. *E.* Asia Minor, 29°.
S. Thessaly, 40°. *W.* Herzegovina, 18°.

4. D. TENUIFLORUS, *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 189; *Boiss. Fl. Orient.* i. p. 507.

Scabrido-pubescens. Caules 42 centim., in ramos dichotomos laxe corymbosos dividentes. Folia 43 mm., linearia acuta stricta adpressa 3-nervia, vagina folii diam. duplo longiore. Inflorescentia corymbosa. Bracteæ obovatæ mucronatæ ad dimidium calycem adpressæ. Calyx dentibus subulatis. Petala contigua; lamina oblonga purpurea maculata, $=\frac{1}{3}$ unguis.

Geogr. limits.—*N.* Servia. *E.* Bulgaria.
S. Rumelia. *W.* Servia.

5. D. GLUTINOSUS, *Boiss. et Heldr. Diagn. Pl. Nov. Or.* ser. II. i. p. 61; *Boiss. Fl. Orient.* i. p. 508.

Valde glanduloso-viscidus, velutinus. Caules 44 centim., ramis dichotomis subunifloris. Folia linearia acuta flaccida incurva 5-nervia, superiora stricta, vagina folii diam. æquante. Flores inodori. Bracteæ oblongo-ovatæ acuminatæ ad dimidium calycem

adpressæ. Calyx dentibus subulatis 9-nerviis. Petala contigua; lamina obovata, superne purpurea maculata, subtus flavida.

Geogr. limits.—*N.* Servia. *E.* Near Smyrna.
S. Near Athens. *W.* Servia.

Sectio ii. Suffruticosi.

Perennes suffruticosi. Folia subfloralia herbacea. Inflorescentia non densa; flores cymis paniculatis v. fasciculis dichotomis, v. solitarii. Petala barbulata.

Subsectio 1. *Tubulosi.*

Calyce apice non attenuato.

* Folia non acerosa. Bracteæ 8–16.

6. D. arboreus, *Linn. Sp. Plant.* ed. I. p. 413; *Boiss. Fl. Orient.* i. p. 499; *Lodd. Botanical Cabinet*, t. 459.

Glaber, glaucus, 100 centim. Trunci rami tortuosi lignosi. Caules inferne lignosi corymbosi teretes foliosi multiflori. Folia 37 mm., linearia acuta canaliculata patentia incurva 3-nervia. Inflorescentia corymbose aggregata speciosa rosea odorata. Bracteæ 8–16 (rarius 10) arcte imbricatæ, obovatæ mucronatæ ad dimidium calycem adpressæ. Calyx dentibus lanceolatis acutis. Petala non contigua; lamina obovato-cuneata maculata, $=\frac{1}{2}$ unguis. Antheræ cæruleæ. Capsula cylindrica. Semina peltata granulata.

Geogr. limits.—*N.* Rumelia, in Turkey. *E.* The Archipelago.
S. Crete. *W.* Morea, in Greece.

7. D. fruticosus, *Linn. Sp. Plant.* ed. I. p. 413; *Boiss. Fl. Orient.* i. p. 499; *Sibth. Fl. Græca*, t. 407.

Glaber, glaucus, 60 centim. Trunci rami tortuosi lignosi. Caules inferne lignosi corymbosi teretes foliosi. Folia 36 mm., obovato-lanceolata obtusa canaliculata patentia incurva 1-nervia. Inflorescentia corymbose aggregata speciosa atrorubens inodora. Bracteæ 8–10 arcte imbricatæ, obovatæ mucronatæ ad $\frac{1}{3}$ calycis adpressæ. Calyx dentibus lanceolatis acutis. Petala non contigua; lamina obovato-cuneata maculata, $=\frac{1}{2}$ unguis. Antheræ rubellæ. Capsula cylindrica. Semina peltata granulata.

Geogr. limits.—The Grecian Archipelago.

8. D. PENDULUS, *Boiss. et Blanche, Diagn. Pl. Nov. Or.* ser. II. vi. p. 28; *Boiss. Fl. Orient.* i. p. 499.

Glaber. Caudex sublignosus multicaulis. Caules 40 centim., foliosi teretes simplices v. stricte ramosi. Folia stricta acuminata, radicalia 72 mm. linearia plana 5-nervia, caulinia 50 mm. elongato-linearia canaliculata 3-nervia, vagina folii diam. æquante. Flores laxi brevissime pedunculati rosei. Bracteæ 12–16 arcte imbricatæ, lanceolatæ acutatæ ad dimidium calycem adpressæ. Calyx dentibus lanceolatis mucronatis 7-nerviis. Petala non contigua; lamina obovato-cuneata, $=\frac{1}{3}$ unguis.

Hab. Syria, and Tripoli in N. Africa.

9. D. ACTINOPETALUS, *Fenzl, Pugill. Pl. Nov. Syr.* p. 11; *Boiss. Fl. Orient.* i. p. 500.

Glaber, glaucus, 45 centim. Caules simplices v. apice breviter ramosi tetragoni tuberculati. Folia stricta adpressa canaliculata; radicalia confertissima linearia acuta 7-nervia, caulinia elongato-linearia acuta 5-nervia, subfloralia fasciculum superantia, vaginis brevissimis. Inflorescentia fasciculis dichotomis 2–3 florum. Bracteæ 8–10 subherbaceæ ovatæ mucronatæ ad $\frac{1}{4}$ calycis partem adpressæ. Calyx dentibus lanceolatis acutis purpureis. Petala contigua; lamina rosea obovata.

Geogr. limits.—*N.* Gulek Boghaz, in the Taurus Mts.
S. The coast of Cilicia.
E. Antioch, in prov. Aleppo.
W. Island of Cos.

10. D. BISIGNANI, *Tenore, Cat. Orto Bot. Princip. Bisignano* (1805), p. 13; *Fl. Nap.* i. (1811–1815), p. 228, t. 39; *Bot. Reg.* 1838, t. 29.

Glaber, 35 centim. Caules inferne teretes, superne tetragoni, ramosi. Folia radicalia 25 mm. lineari-lanceolata acuta recurva 5-nervia, caulinia 37 mm. linearia acuminata patentia incurva 3-nervia plana, vaginis brevibus. Flores cymis laxis 3–5-fasciculati breviter pedunculati speciosi. Bracteæ 8, obovato-lanceolatæ mucronatæ ad $\frac{1}{3}$ calycis adpressæ. Calyx dentibus lanceolatis acuminatis purpureis 11-nerviis. Petala contigua; lamina obovato-cuneata rosea, $=\frac{1}{2}$ unguis. Antheræ rubellæ.

a. glaucus, *mihi*, vide *Reichb. Ic. Bot. Pl. Crit.* t. 591. f. 810.

b. viridescens, *Guss. Fl. Sic. syn.* i. p. 478.

c. albiflorus, *Presl, Fl. Sicula,* i. p. 145.

d. hermæensis, *Coss.* (sp.), *Illustr. Fl. Atlant.* p. 121, t. 76.

Geogr. limits.—*N.* Naples. *E.* Otranto.
S. Tunis. *W.* Tunis.

11. D. VIRGATUS, *Pasq. in Ann. Accad. Asp. Nat.* ser. III. i. (1861), p. 28; *Cat. orto bot. Nap.* (1867) p. 37.

Glaucus, 60 centim. Caudex subcorticatus. Caules paniculis dichotomis virgatis ramosi. Folia elongato-linearia acuminata. Bracteæ 12, ovatæ acutæ adpressæ.

Hab. Calabria.

12. D. BERTOLONII, *Woods, Tour. Fl.* (1850) p. 45; *Bertol. Fl. Italica*, iv. p. 551 (D. Bisignani).

60 centim. Caules ramosi. Folia linearia acuta carinata. Flores fastigiati rosei. Bracteæ 8 lanceolatæ acuminatæ ad $\frac{1}{3}$ calycis adpressæ. Calyx dentibus lanceolatis acuminatis margine membranaceis. Lamina obovato-spathulata.

Hab. S. Italy.

** Caules 1–2-flori. Folia non acerosa. Bracteæ 4–6.

13. D. ELEGANS, *Urv. in Mém. Soc. Linn. Paris* (1822) p. 302; *Boiss. Fl. Orient.* i. p. 500.

Cæspitosus, glaber. Caules 22 centim., simplices pauciflori tenues tetragoni. Folia 44 mm., linearia acuminata stricta plana patentia 3–5-nervia, vagina folii diam. duplo longiore. Flores cymis laxis rosei. Bracteæ scariosæ obovatæ mucronatæ ad $\frac{1}{3}$ calycis, adpressæ. Calyx purpureus, dentibus lanceolatis acutis. Petala contigua; lamina obovato-cuneata.

Geogr. limits.—*N.* Sipuli, in Anatolia, 39°.
S. The coast of Cilicia, 36°.
E. Tarsus, in Cilicia, 35°.
W. Island of Cos, 27°.

*** Rami floriferi 1–2-flori. Folia acerosa, pungentia. Bracteæ 4–6.

14. D. JUNIPERINUS, *Sm. in Trans. Linn. Soc.* ii. (1794) p. 303; *Boiss. Fl. Orient.* i. p. 498 [*Alpini, Exot.* p. 39, t. 38].

Cæspitosus, glaber. Caules 15 centim., teretes ramosi foliosi. Folia 25 mm., rigida aciculata canaliculata adpressa, vagina folii diam. æquante. Flores odorati parvi breviter pedunculati cymis

laxis. Bracteæ obcordatæ mucronatæ ad dimidium calycem adpressæ coriaceæ. Calyx dentibus lanceolatis acuminatis ciliatis. Petala contigua; lamina obovato-cuneata rosea.

Hab. Crete.

15. D. ACIPHYLLUS, *Sieber, in DC. Prodr.* i. p. 358; *Boiss. Fl. Orient.* i. p. 498.

Cæspitosus, glaber. Caules 30 centim., teretes paniculatim cymosi foliosi. Folia 40 mm., rigida aciculata plana adpressa, vagina folii diam. æquante. Bracteæ obcordatæ mucronatæ ad dimidium calycem adpressæ coriaceæ. Calyx dentibus lanceolatis acuminatis ciliatis. Petala contigua; lamina rosea.

Hab. Crete.

16. D. RIGIDUS, *Bieb. Fl. Taur. Cauc.* i. p. 325, iii. p. 298; *Ledeb. Fl. Rossica*, i. p. 280; *Tratt. Thes.* 68.

Cæspitosus, scaber. Caules 44 centim., teretes ramosi tenues. Folia 25 mm. aciculata patentia canaliculata, supremis squamiformibus, vaginis brevibus. Bracteæ obovatæ mucronatæ ad $\frac{1}{4}$ calycis partem adpressæ stramineæ. Calyx dentibus lanceolatis acutis 9-nerviis. Lamina oblonga rosea.

Hab. S.E. Russia.

Subsectio 2. *Contracti.*

Calyce apice attenuato.

17. D. FRIWALDSKYANUS, *Boiss. Diagn. Pl. Nov. Or.* ser. II. i. p. 65; *Fl. Orient.* i. p. 500.

Glaucus, inferne scabridulus. Caules 20 centim., foliosi simplices, inferne angulariter geniculati, superne teretes. Folia 12 mm., triquetra linearia acuta stricta patentia carinata 3-nervia, vagina folii diam. duplo longiore. Flores 2–3 congesti pedunculis brevibus. Bracteæ 6, obovatæ mucronatæ ad $\frac{1}{3}$ calycis partem patentes coriaceæ. Calyx dentibus lanceolatis mucronatis. Lamina obovato-cuneata rosea subtus pallida.

Hab. The Balkan Mts., in both N. Bulgaria and E. Rumelia; near Bilrai in Anatolia.

18. D. GRACILIS, *Sibth. Fl. Græca*, v. p. 3, t. 404; *Boiss. Fl. Orient.* i. p. 501.

Glaber, glaucus, 36 centim. Caules simplices tetragoni tenues. Folia 55 mm., linearia acuta stricta plana patentia

3-nervia, vagina folii diam. 4-plo longiore, subfloralia subulata straminea. Flores 2–3 congesti pedunculis brevibus. Bracteæ 4, elliptico-oblongæ acuminatæ ad dimidium calycem pallidæ coriaceæ adpressæ. Calyx dentibus lanceolatis acutis. Petala contigua; lamina=unguem, rosea, subtus pallidissima, obovato-cuneata. Antheræ purpureæ.

b. pumilus, *Boiss. Fl. Orient.* i. p. 501.

9 centim. Folia rigida pungentia, vagina folii diam. 3-plo longiore.

c. armerioides, *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 190; *Boiss. Fl. Orient.* i. p. 501; *Reichb. Ic. Bot. Pl. Crit.* 739 (D. collinus).

Scabridulus. Vagina folii diam. duplo longiore. Flores dense fasciculati. Bracteæ ovatæ.

Geogr. limits.—*N.* The Balkan Mtns., 43°.
S. Mt. Athos in Rumelia, 40°.

19. D. BIFLORUS, *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 189 (non *Smith*); *Boiss. Fl. Orient.* i. p. 501.

Glaber. Caules 40 centim., simplices tetragoni. Folia 70 mm. linearia acuta stricta plana patentia 3-nervia, vagina folii diam. æquante, subfloralia subulata straminea. Bracteæ 4, elliptico-oblongæ acuminatæ ad dimidium calycem coriaceæ patentes. Calyx dentibus lanceolato-ovatæ mucronatæ. Lamina rosea obovato-cuneata. Capsula cylindrica.

Geogr. area.—Rumelia.

20. D. MERCURII, *Heldr. in Atti Congr. Bot. Firenze* (1874), p. 237; *Boiss. Fl. Orient., Supplem.* p. 78.

Glaber, glaucus, 46 centim. Caules simplices teretes tenues. Folia 75 mm., elongato-linearia acuminata plana patentia 7-nervia, vagina folii diam. 3-plo longiore. Flores laxi. Bracteæ 6, obovato-lanceolatæ mucronulatæ ad dimidium calycem patentes purpureæ. Calyx purpureus, dentibus lanceolatis acuminatis. Petala contigua; lamina obovata rosea, subtus flavicante.

Hab. Morea, in Greece.

Sectio iii. CARTHUSIANUM.

Herbæ perennes. Folia subfloralia scariosa, rarissime herbacea. Inflorescentia densa, capitata. Petala nonnunquam imberbia.

Subsectio 1. *Microlepides.*

Caules teretes. Folia subfloralia scariosa. Bracteæ lanceolatæ. Calyx dentibus lanceolatis acuminatis v. acutis.

* Bracteæ herbaceæ. Petala imberbia.

21. D. TRIFASCICULATUS, *Kit. in Schultes, Oesterreichs Flora*, ed. II. i. p. 654; *Schur, Enum. Pl. Transsilvaniæ*, p. 95; *Reichb. Ic. Fl. Germ. Helv.* 5021.

Glaber. Caules 72 centim., foliosi simplices. Folia leari-oblonga stricta acuminata 7–9-nervia patentia, vagina folii diam. duplo longiore, radicalia 118 mm., caulinia 90 mm., subfloralia capitulum multum superantia. Inflorescentia conglobata fasciculis trichotomis 6–8 florum. Bracteæ 4 acuminatæ ad calycis apices v. superantes. Calyx apice attenuato, dentibus purpureis ciliatis 9-nerviis. Petala contigua; lamina obovato-cuneata purpurea, $=\frac{1}{2}$ unguis. Antheræ cæruleæ.

b. pauciflorus, *Brandza, Prod. Fl. Romane*, p. 192; *auct. Pinks of Cent. Eur.* p. 7.

Geogr. limits.—*N.* Galicia, in Austria, 50°.
S. Near Rasgrad, in N. Bulgaria, 44°.
E. Kherson, in South Russia, 23°.
W. County of Karlstadt, in Croatia, 15°.

** Bracteæ scariosæ. Petala imberbia.

22. D. NARDIFORMIS, *Janka, in Oesterr. Bot. Zeitschr.* 1873, p. 195; *Panč. Elem. Fl. Princip. Bulgariæ* (1883).

Cæspitosus, 17 centim. Folia stricta patentia, vagina folii diam. 3-plo longiore. Flores cymoso-fasciculati rosei. Bracteæ 4 obcordatæ. Calyx apice attenuato, dentibus acutis. Lamina $=\frac{1}{2}$ unguis.

Geogr. limits.—*E.* Tultcha, in Dobrudscha, at the mouth of the Danube.
W. Banialouka, in Bosnia, on the Verbas.

23. D. LIBURNICUS, *Bartl. in Wendl. Beitrag z. Botanik*, ii. p. 52; *Gren. et Godr. Fl. de France*, i. p. 231; *Reichb. Ic. Fl. Germ. Helv.* 5015.

Glaber. Caules 48 centim., simplices stricti, superne fere quadranguli. Folia plana stricta acuminata, radicalia 75 mm., 5-nervia recurva linearia, caulinia 58 mm. 7-nervia adpressa lineari-lanceolata, vagina folii diam. duplo longiore, subfloralia 2 adpressa coriacea. Inflorescentia capitulis simplicibus 4–6

florum. Bracteæ 4 acuminatæ ad calycis apices. Calyx dentibus 7-nerviis acuminatis purpureis. Petala contigua; lamina obovato-cuneata rosea maculata, $=\frac{1}{2}$ unguis. Antheræ lineari-oblongæ, cæruleæ.

b. ligusticus, *Willd.* (sp.) *vide Sweet, Flow. Gard.* ii. t. 23 (D. Balbisii).

c. propinquus, *Schur* (sp.), *Enum. Pl. Transsilvaniæ*, p. 94; *Reichb. Ic. Fl. Germ. Helv.* 5015 *c* (D. glaucophyllus).

Vagina folii diam. 4-plo longiore.

d. brachycarpus, *Velen.* (sp.), *in Abhandl. k. Böhm. Gesellsch.* 1886, n. 8, p. 9.

Vagina folii diam. æquante.

Geogr. limits.—*N.* Galicia, in Austria, 48°.
S. Albania, 40°.
E. Podolia, in Russia, 30°.
W. Languedoc, 4°.

24. D. TYMPHRESTEUS, *Heldr. et Sart. in Boiss. Diagn. Pl. Nov. Or.* ser. I. viii. p. 64; *Boiss. Fl. Orient.* i. p. 509.

Cæspitosus, hirsutus, viscidulus. Caules nani 25 centim., numerosi. Folia elongato-linearia acuminata patentia incurva, vaginis brevibus, subfloralia apice subherbacea. Flores fasciculati, breviter pedunculati. Bracteæ 4 ventricosæ, mucronulatæ ad $\frac{1}{3}$ calycis partem, pallidæ patentes. Calyx dentibus acutis. Petala non contigua; lamina obovato-cuneata maculata.

Hab. Greece.

*** Bracteæ scariosæ. Petala barbulata.

25. D. TRANSSILVANICUS, *Schur, in Verhandl. Mittheil. d. Siebenburg. Ver. f. Naturwissensch.* 1854, p. 82; *Enum. Pl. Transsilvaniæ*, p. 95.

Glaber. Caules 72 centim., simplices. Folia lineari-oblonga stricta acuminata patentia, vagina folii diam. æquante, radicalia 114 mm. 7-nervia, caulinia 90 mm. 5-nervia, subfloralia capitulum æquantia. Inflorescentia aggregata fasciculis dichotomis 6–18 florum. Bracteæ 4 acuminatæ ad calycis apices. Calyx apice attenuato, dentibus acuminatis hyalino-marginatis 7-nerviis. Petala contigua; lamina obovato-cuneata rubra, $=\frac{1}{2}$ unguis. Antheræ cæruleæ.

a. biternatus, *mihi, Pinks Cent. Eur.* p. 7.

Capitulum biternato-fastigiatum.

b. triternatus, *mihi*, *Pinks Cent. Eur.* p. 7. (=D. trifasciculatus, *Schur*).

Capitulum triternato-fastigiatum.

Hab. Transylvania.

26. D. HEPTANEURUS, *Griseb.*, *in Wiegmann*, *Archiv*, 1852, p. 302; *auct. Pinks Cent. Eur.* p. 7.

Glaber. Caules 70 centim., simplices. Folia lineari-oblonga stricta acuminata, vagina folii diam. æquante, 7-nervia, subfloralia fasciculum æquantia. Flores fasciculati. Bracteæ squarroso-patentes calycem æquantes. Calyx purpureus, dentibus acutis ciliolatis 7-nerviis. Petala contigua; lamina ovato-rotunda rubra.

b. lancifolius, *Tausch* (sp.), *in Flora* (1831), i. p. 215; *Reichb. Fl. Germ. Excurs.* p. 804.

Folia lineari-lanceolata. Bracteæ calyce subbreviores.

An obscure form, which perhaps may be referred to this species.

Hab. Hungary.

27. D. VISCIDUS, *Bory et Chaub. Fl. de Morée*, p. 26; *Boiss. Fl. Orient.* i. p. 509.

Cæspitosus, pubescenti-viscidulus, 28 centim. Caules simplices. Folia linearia acuminata plana flaccida, 1–3-nervia, radicalia 30 mm. patentia recurva, caulinia 25 mm. adpressa, vagina folii diam. æquante, folia subfloralia obcordata. Flores 3–6 fasciculato-capitati. Bracteæ 4 (v. 2) ventricosæ, acuminatæ ad $\frac{1}{3}$–$\frac{2}{3}$ calycis partem, adpressæ. Calyx dentibus rubellis acuminatis. Petala contigua; lamina obovato-cuneata paucidentata purpurea maculata.

b. olympicus, *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 19; *Griseb. Spicil. Fl. Rumel. Bithyn.* ii. p. 503.

Folia 3-nervia, vagina folii diam. duplo longiore. Flores 6 in capitulo. Bracteæ 4.

c. parnassicus, *Boiss. Diagn. Pl. Nov. Or.* ser. II. i. p. 64; *Fl. Orient.* i. p. 509.

Folia uninervia. Flores 3–4 in fasciculo. Bracteæ 4 attingentes $\frac{1}{3}$ calycis. Calyx apice attenuato.

d. Grisebachii, *Boiss. Diagn. Pl. Nov. Or.* ser. II. i. p. 62; *Fl. Orient.* i. p. 509; *Bory et Chaub. Fl. de Morée*, t. 12.

Folia 3-nervia incurva. Flores 2–3 in fasciculo. Bracteæ 2, planæ obcordatæ ad dimidium calycem.

e. Heldreichii, *Orph.* (sp.) *Exsiccat.* n. 914; *Nym. Consp. Pl. Eur., Suppl.* ii. p. 58.

Hab. Bulgaria, Turkey, and Greece.

28. D. JAPONICUS, *Thunb. Fl. Japonica*, p. 183, t. 23; *Rohrb. in Linnæa*, xxxvi. (1870), p. 669; *Fl. des Serres*, t. 1172.

Glaber. Caules simplices, 50 centim. Folia 48 mm., ovato-lanceolata acuta canaliculata basi contorta, vagina folii diam. æquante, subfloralia lanceolata. Inflorescentia fasciculis trichotomis 6–8 florum. Bracteæ 4 acuminatæ ad $\frac{1}{3}$ calycis partem, patentes. Calyx dentibus acuminatis. Petala contigua; lamina rubra cuneata. Semina punctulata.

b. platyphyllus, *Turcz.* (sp.) *Animadv. in Bull. Soc. Nat. Mosc.* xxvii. (1854) pt. 2, p. 368.

Folia oblongo-lanceolata, basilaria 72 mm. longe attenuata, subfloralia ovato-oblonga, vagina folii diam. duplo longiore.

c. brachycalycina, *Maxim.*—Calyx 12–15 mm.

Geogr. area.—Japan and Manchuria.

29. D. MUSCHIANUS, *Boiss. Fl. Orient.* i. p. 510.

Cæspitosus, pubescens. Caules simplices, 10 centim. Folia 12 mm., oblongo-lanceolata acuta canaliculata basi contorta patentia 3-nervia, vagina folii diam. æquante. Inflorescentia fasciculis 3 florum. Bracteæ 2 acuminatæ ad dimidium calycem, patentes. Calyx purpureus apice attenuato, dentibus acuminatis. Petala contigua; lamina purpurea cuneata.

b. major, *Boiss. Fl. Orient.* i. p. 510.

Caules 18 centim.

Hab. Provinces of Musch and Diarbekir, in Asiatic Turkey.

30. D. PINIFOLIUS, *Sibth. et Sm. Fl. Græcæ Prodr.* i. p. 284; *Boiss. Fl. Orient.* i. p. 514; *Friv. in Act. Acad. Hung.* 1840, t. 8 (D. brevifolius).

Cæspitosus, scabridus. Caules 42 centim., foliosi simplices stricti. Folia 37 mm., aciculata, radicalia recurva, caulinia uninervia stricta adpressa, vagina folii diam. duplo longiore, subfloralia obcordata obtusissima aristata longitudine capituli. Inflorescentia cymis capitatis 5–8 florum inodororum aggregata. Bracteæ [illegible], mucronato-aristatæ ad dimidium calycem, patentes. Calyx rubens, dentibus acuminatis. Petala contigua; lamina ovato-oblonga rosea, = $\frac{1}{2}$ unguis.

b. serbicus, *Wettst. Beitr. Fl. Alban.* (1892) p. 34.

Bracteæ interiores longiores.

Geogr. limits:—

N. Wallachia.

S. Island of Lemnos, in the Turkish Archipelago.

E. Near Constantinople.

W. West Servia.

31. D. CIBRARIUS, *Clem. in Mem. Accad. Sc. Torino*, ser. II. xvi. (1857), p. 256; *Boiss. Fl. Orient.* i. p. 513; *Clem. Sert. Olymp.* t. 2.

Hispidus, 30 centim. Caules ramosi. Folia linearia acuta patentia carinata, radicalia recurva pungentia 7-nervia, caulinia stricta 5-nervia, vagina folii diam. 6-plo longiore. Inflorescentia cymis capitatis 6–8 florum. Bracteæ 4 mucronato-setaceæ ad calycis apices, patentes fusco-sanguineæ. Calyx rubellus apice attenuato, dentibus pungentibus acutis ciliolatis 7-nerviis. Petala contigua; lamina obovato-cuneata purpurea, $=\frac{1}{3}$ unguis.

Hab. Alpine pastures of Khesish-Dagh, in Anatolia.

32. D. CALOCEPHALUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. vi. p. 23; *Fl. Orient.* i. p. 515.

Glaber, glaucus. Caules 80 centim., simplices. Folia linearia acuta canaliculata patentia recurva 5-nervia, radicalia 100 mm. paucissima, caulinia 75 mm. remote disposita, vagina folii diam. 4-plo longiore. Inflorescentia in capitula corymborum densorum 5–7 florum congesta. Bracteæ 6 acuminatæ ad $\frac{1}{3}$ calycis, patentes. Calyx rubens, dentibus acuminatis 7-nerviis. Petala contigua; lamina obovato-cuneata lateritio-rubella maculata, $=\frac{1}{4}$ unguis.

Geogr. limits.—*N.* Komadara, in Russian Armenia, 42°.
S. Antioch, in prov. of Aleppo, 36°.
E. Gumuchkhane, in Turkish Armenia, 44°.
W. Montenegro, near the Bosnian frontier, 20°.

33. D. GIGANTEUS, *Urv. in Mém. Soc. Linn. Paris* (1822), p. 300; *Borb. in Act. Acad. Hung.* 1875; *Sweet, Flow. Gard.* t. 288.

Cæspitosus, glaber, glaucus. Caules 72 centim., simplices. Folia elongato-linearia 7-nervia stricta plana acuminata patentia, vagina folii diam. 4-plo longiore, subfloralia lanceolata mucronata capitulum superantia. Inflorescentia capitulis aggregata 10–12 florum. Bracteæ 4 mucronatæ ad dimidium calycem, fusco-sanguineæ. Calyx purpureus apice attenuato, dentibus acuminatis 9-nerviis. Petala non contigua; lamina rubra obovato-cuneata, $=\frac{1}{2}$ unguis. Antheræ cæruleæ.

b. humilior, *Borb. in Akad. Kösl.* xii. p. 83.

c. pergiganteus, *Borb. in Oesterr. Bot. Zeitschr.* 1882, p. 101.

Geogr. limits.—*N.* Moldavia. *E.* Dobrudscha.
S. Bulgaria. *W.* Servia.

34. D. BANATICUS, *Heuff. in Griseb. It. Hung. in Wiegmann, Archiv*, 1852, p. 302; *Boiss. Fl. Orient.* i. p. 515; *Regel, Gartenfl.* v. p. 153.

Glaber, glaucus. Caules 30 centim., simplices. Folia 75 mm., 5-nervia patentia recurva, vagina folii diam. 4-plo longiore, subfloralia ad apices bractearum acutata. Inflorescentia capitulis aggregata 10–12 florum. Bracteæ 4 acuminatæ ad dimidium calycem, fusco-sanguineæ. Calyx dentibus acuminatis purpureis. Petala non contigua; lamina rubra obovato-cuneata, = ½ unguis. Antheræ cæruleæ.

b. biternatus, *Schur* (sp.), *in Verhandl. Mittheil. d. Siebenb. Ver. f. Wissensch.* 1854, p. 83; *Enum. Pl. Transsilvaniæ*, p. 94.

Caules ad apices foliati. Vagina subinflata folii diam. 5-plo longiore. Flores biternati conglobati quandoque fastigiato-capitati.

c. pruinosus, *Janka* (sp.), *Delect. Sem. Hort. Vindob.* 1858, p. 4; *in Ann. Sc. Nat. (Bot.)* 1859, p. 164.

Folia vix flaccida.

d. ponticus, *Wahlenb.* (sp.), *in Isis,* xxi. p. 985; *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 195.

Folia suboblongo-linearia.

Geogr. limits.—*N.* Moldavia. *E.* Wallachia.
S. Bulgaria. *W.* Bosnia.

Subsectio 2. *Carthusianoides.*

Folia stricta, subfloralia scariosa. Bracteæ siccæ. Calyx dentibus lanceolatis, acuminatis acutis v. rarius mucronatis. Petala obovato-cuneata, barbulata.

* Dentes calycis acuminati v. acuti.

35. D. CARTHUSIANORUM, *Linn. Sp. Plant.* ed. I. p. 409; *Boiss. Fl. Orient.* i. p. 512; *Reichb. Ic. Fl. Germ. Helv.* 5019.

Cæspitosus, glaber aut scaber, viridis, rarius glaucus. Caules 24–40 centim., e rhizomate multicipite, simplices 4-angulares erecti. Folia linearia elongato-linearia aut rarius acicularia longe acuminata plana 5-nervia (3 prominenter validis, 2 tenuibus obscurioribus), vagina folii diam. 3-plo sæpius 4-plo longiore, subfloralia elliptica sæpius ad apices bractearum acutata calyces non occultantia. Inflorescentia fasciculis sæpius paucifloris aut interdum multifloris capitatis 2–30 florum inodororum pedicellis

brevibus aut subsessilium. Bracteæ 4 coriaceæ fuscæ aut stramineæ, planæ aut ventricosæ, plerumque obovatæ, obtusæ aut truncatæ in mucronem attenuatæ aut aristatæ calyce duplo breviores, adpressæ. Calyx purpureo-fuscus aut basi viridis, apice attenuato, dentibus acuminatis interdum acutis 9-nerviis. Petala sæpius contigua; laminâ patentissimâ unguem æquante aut eo duplo breviore. Capsula cylindrica.

Grex eu-Carthusianorum.—Viridis, glaber. Vagina folii diam. 4-plo longiore. Capitulum pauciflorum; floribus 2–6, laminâ = unguem.

a. eu-Carthusianorum (vide *Reichb. Ic. Fl. Germ. Helv.* 5019).

36 centim. Folia elongato-linearia, radicalia 80 mm., caulinia 55 mm., subfloralia e nodo prodeuntia. Bracteæ elliptico-oblongæ ventricosæ coriaceæ rectæ. Calycis dentes acuminati. Lamina purpurea.

b. curticeps, *Borb. in Oesterr. Bot. Zeitschr.* 1890, p. 97; *auct. Pinks Cent. Eur.* p. 11.

Calyx brevior, dentibus acutis.

c. pratensis, *Neilr. Diagn. Plant. Hung. Slavon.* p. 21; *auct. Pinks Cent. Eur.* p. 11 (= D. Carthusianorum, *Sturm.*); *Deutsch. Fl.*, Heft 27.

30 centim. Capitulum 3–6 florum. Bracteæ oblongæ planæ fuscæ rectæ. Calycis dentes acuminati. Lamina purpurea.

d. pumilus, *Schur, Enum. Pl. Transsilvaniæ*, p. 95; *auct. Pinks Cent. Eur.* p. 11 (= D. subneglectus, *Schur*).

10 centim. Caules tenuissimi. Folia linearia internodium superantia. Capitulum 3–6 florum. Bracteæ subrhomboidales. Calycis dentes acuminati. Lamina purpurea.

e. subalpestris, *Schleich. in Gaud. Fl. Helvetica*, iii. p. 144.

20 centim. Capitulum 3–6 florum. Bracteæ stramineæ truncato-mucronatæ. Lamina suprà purpurea, infrà lutea.

f. anisopodus, *Ser. in DC. Prodr.* i. p. 357.

Bracteæ oblongæ planæ fuscæ. Calycis dentes acuti. Lamina purpurea.

Grex subfastigiati.—Viridis, puberulus. Vagina folii diam. 3-plo longiore. Capitulum multiflorum, floribus 6–14, laminâ = unguem.

g. subfastigiatus, *Schur, Enum. Pl. Transsilvaniæ*, p. 92; *Baumg. Stirp. Transsilv.* (D. atrorubens).

Inferne puberulus, superne fere glaber, 36 centim. Inflorescentia fastigiato-capitata, capitulis 4–8 florum. Bracteæ stramineæ, interiores ovato-oblongæ, exteriores oblongæ. Lamina atrorubens.

h. australis, *Panč. in. Akad. Kösl.* 1878, p. 531; *auct. Pinks Cent. Eur.* p. 12 (= D. puberulus, *Simk.*).

Omnino puberulus. Folia radicalia elongato-linearia, caulinia linearia. Inflorescentia fastigiato-capitata, capitulis 8–14 florum. Bracteæ fuscæ planæ oblongæ. Lamina atrorubens.

Grex graminei.—Viridis aut glaucus, scaber. Vagina folii diam. 3–4-plo longiore. Capitulum pauciflorum, floribus 2–6, lamina = ½ unguis.

i. gramineus, *Schur in Verhandl. Mittheil. d. Siebenb. Ver. f. Naturwissensch.* 1851, p. 177; *auct. Pinks Cent. Eur.* p. 12 (=*var.* tenuis *idem.*).

Glaucus. Caules tenuissimi. Folia linearia. Capitulum 4–5 florum. Bracteæ stramineæ subrhomboidales. Lamina purpurea.

j. tenuifolius, *Schur in Oesterr. Bot. Zeitschr.* 1858, p. 22; *auct. Pinks Cent. Eur.* p. 12.

Viridis. Caules tenuissimi. Folia linearia, vix stricta, 80–90 mm., internodium superantia. Capitulum 3–6 florum. Bracteæ brunneæ coriaceæ subcordatæ obtusissimæ. Lamina rubra.

k. chloæphyllus, *Schur* (sp.), *Enum. Pl. Transsilvaniæ*, p. 95; *auct. Pinks Cent. Eur.* p. 12.

Glaucus, 13 centim. Folia elongato-linearia, vix stricta, vagina folii diam. 3-plo longiore. Capitulum 3–6 florum. Bracteæ flavæ subcordatæ obtusissimæ. Lamina rosea.

l. rupicolus, *Schur in Herb. Kew.*; *auct. Pinks Cent. Eur.* p. 12.

Caules numerosi, 40 centim. Folia linearia, vagina folii diam. 3-plo longiore. Capitulum 2–6 florum congestorum. Bracteæ stramineæ obtusissimæ oblongæ ventricosæ. Lamina atrorubens.

m. saxigenus, *Schur, Enum. Pl. Transsilvaniæ*, p. 93; *auct. Pinks Cent. Eur.* p. 12.

Caules numerosi, 50 centim. Folia linearia, vagina folii diam. 4-plo longiore. Capitulum 2–6 florum congestorum. Bracteæ stramineæ obtusissimæ planæ, exteriores ovatæ, interiores obovatæ. Lamina atropurpurea.

Grex ferruginei.—Viridis, glaber. Vagina folii diam. 4-plo

longiore. Capitulum multiflorum; floribus 8–16; lamina = $\frac{1}{2}$ unguis.

n. ferrugineus, *Mill.* (sp.) *Gard. Dict.* ed. VIII. (1768), no. 9; *Linn. Mantissa* (1771), p. 563; *Bot. Reg.* (1839), t. 15.

38 centim. Folia elongato-linearia. Capitulum sphæricum 8–10 florum aggregatorum. Bracteæ stramineæ oblongæ. Lamina reflexa, suprà sulphurea, infrà ferruginea.

o. Pontederæ, *Kern.* (sp.) *in Oesterr. Bot. Zeitschr.* 1868, p. 89; *Tanfani, in Parl. Fl. Italiana*, ix. p. 254.

Folia radicalia linearia, caulinia elongato-linearia. Fasciculus 6–12 florum. Bracteæ oblongæ brunneæ planæ. Calycis dentes triangulares. Lamina suprà rubello-purpurea, subtus rosea.

p. nanus, *Ser. in DC. Prodr.* i. p. 357; *auct. Pinks Cent. Eur.* p. 13 (= var. intermedius, *Gaud.*).

Caules pauci, 7 centim. Folia radicalia linearia, caulinia elongato-linearia. Capitulum 8–14 florum. Bracteæ elliptico-oblongæ stramineæ ventricosæ. Calycis dentes triangulares. Lamina purpurea.

q. atrorubens, *All.* (sp.) *Fl. Pedemont.* ii. p. 75; *Boiss. Fl. Orient.* i. p. 512; *Reichb. Ic. Fl. Germ. Helv.* f. 5016.

65 centim. Folia elongato-linearia, subfloralia oblonga in cuspidem attenuata. Bracteæ oblongæ planæ, basi subherbaceæ tunc rubello-scariosæ. Lamina atrorubens. (= D. vaginatus, *Vill.*)

r. congestus, *Bor.* (sp.) *Fl. Cent. France*, ed. III. p. 90; *Gren. et Godr. Fl. de France*, i. p. 232; *Lapeyr. Hist. Abr. Pl. Pyren.* p. 58, t. 6.

Folia elongato-linearia. Capitula 8–14 florum. Bracteæ stramineæ oblongæ planæ. Lamina atrorubens. (= D. atrorubens, *Lois.*)

s. parviflorus, *Schur, Enum. Pl. Transsilvaniæ*, p. 93; *auct. Pinks Cent. Eur.* p. 14; *Reichb. Ic. Fl. Germ. Helv.* 5017 (D. diutinus).

25 centim. Folia elongato-linearia. Capitula subtrifasciculata; floribus 8–9. Bracteæ obovatæ ventricosæ. Calyx et lamina atrorubentes.

t. bohemicus, *mihi, in Pinks Cent. Eur.* p. 13 (= *var.* parviflorus, *Celak.*); *Prod. Fl. Boehmens.*

45–60 centim. Folia linearia. Capitula subtrifasciculata;

floribus 10–11. Bracteæ obovatæ ventricosæ. Calyx basi viridis tunc purpureo-fuscus. Lamina atrorubens.

u. giganteiformis, *Borb.* (sp.) *in Bot. Zeitung*, 1876, p. 357; *cfr. Borb. in Akad. Kösl.* 1875.

72 centim. Folia linearia, subfloralia lanceolata. Capitulum 10–12 florum. Calyx et lamina atrorubentes, lamina minima.

Grex pauciflori.—Viridis, glaber. Vagina folii diam. 4-plo longiore. Capitulum pauciflorum, floribus 2–6, lamina $= \frac{1}{2}$ unguis.

v. pauciflorus, *Bruegg, Cent. Alpenflora* (1856), p. 83; *Journ. Bot.* xxiii. (1885), p. 341.

38 centim. Fasciculi 2–5 florum. Bracteæ oblongæ stramineæ planæ. Lamina atrorubens.

x. Sabuletorum, *Heuff. in Verhandl. d. zool.-bot. Gesellsch. in Wien*, 1858, p. 68; *Heuff. in Oesterr. Bot. Zeitschr.* 1858, p. 26.

30 centim. Folia elongato-linearia. Capitulum 2–3 florum. Bracteæ subrotundæ stramineæ apice fuscæ rectæ. Calycis dentes triangulares. Lamina pallide purpurea (= *var.* arenarius, *Heuff.* ex *Neilr.*).

y. minor, *Schur*, *Herb. Kew.*; *auct. Pinks Cent. Eur.* p. 13.

19 centim. Folia elongato-linearia. Fasciculus 2–5 florum. Bracteæ oblongæ stramineæ planæ. Lamina atrorubens.

z. vulturius, *Guss. et Ten.* (sp.) *Ind. sem. Hort. Neap.* 1837, p. 3, et 1839, p. 11; *Cat. Orto Nap.* 1845, p. 84; *Ten. Peregrinat.* 1838, t. 1.

36 centim. Folia elongato-linearia rigida pungentia. Fasciculus 3–6 florum. Bracteæ oblongæ stramineæ planæ truncatæ vix mucronatæ. Calycis dentes acuminati. Lamina pallide purpurea.

*a*². Jacquinianus, *mihi*, (= D. atrorubens, *Jacq.*), *Pl. Rar. Schönbr.* icon. 467; *auct. Pinks Cent. Eur.* p. 14; *Reichb. Ic. Fl. Germ. Helv.* f. 5015 c.

30 centim. Folia linearia. Capitulum 3–6 florum. Bracteæ obovatæ stramineæ ventricosæ. Calycis dentes acuminatæ. Lamina purpurea.

*b*². ternatus, *Heuff. in Verhandl. Mittheil. d. Siebenb. Verein. f. Wissensch.* 1858, p. 11; *Neilr. Diagn. Plant.* (1867) p. 21.

64 centim. Folia linearia. Inflorescentia fasciculis ternatis, flore medio sessili. Bracteæ obovatæ ventricosæ fusco-rubræ

margine brunneo-scariosæ. Calycis dentes acuti. Lamina purpurea. (= D. vaginatus, *Wierzb.*)

c^2. campestris, *Heuff. in Verhandl. d. zool.-bot. Gesellsch. in Wien*, 1858, p. 32; *Neilr. Diagn. Plant.* (1867) p. 21.

Caules pauci, 8–12 centim. Folia linearia. Fasciculus 2–3 florum. Bracteæ elliptico-oblongæ ventricosæ stramineæ apice brunneæ rectæ. Calycis dentes acuti. Lamina purpurea. (= *var.* nanus, *Neilr.*)

Grex glaucophylli.—Glaber, glaucus. Fasciculus pauciflorus; floribus 2–6; lamina $=\frac{1}{2}$ unguis.

d^2. glaucophyllus, *Wierzb. Pl. Banat.* iii.; *auct. Pinks Cent. Eur.* p. 14.

13 centim. Bracteæ lanceolatæ vix mucronatæ stramineæ. Calycis dentes acuminati. Lamina rubra. (= D. danubialis, *Griseb.*)

e^2. roridus, *Schur, Enum. Pl. Transsilvaniæ*, p. 92; *auct. Pinks Cent. Eur.* p. 14.

26 centim. Bracteæ oblongæ planæ stramineæ. Calycis dentes acuminati. Lamina atrorubens.

Grex lancifolii.—Viridis. Folia lanceolato-linearia. Capitulum pauciflorum; lamina $= \frac{1}{2}$ unguis.

f^2. lancifolius, *Schloss. et Vukotin. Fl. Croatica*, p. 317; *F. Schultz, Herb.* ix. n. 825.

Capitulum 4–6 florum. Folia subfloralia et bracteæ ovato-subulata. Calycis dentes acuti. Lamina purpurea.

Grex mœsiaci.—Viridis. Folia acicularia, vagina rubella folii diam. $2\frac{1}{2}$-plo longiore. Capitulum sphæricum; floribus 4–16; lamina $= \frac{1}{2}$ unguis.

g^2. mœsiacus, *Panč.* (sp.) *Pl. Serbicæ Rar.* dec. iii. p. 17, t. 19; *auct. Pinks Cent. Eur.* p. 14.

Scabridus, 35 centim. Folia inferiora 110 mm., reliqua 36 mm. rigida. Capitulum 10–14 florum cymoso-aggregatorum. Bracteæ oblanceolatæ stramineæ vix adpressæ apice purpurascentes. Calyx purpureo-fuscus, dentibus acuminatis. Lamina rosea. (= D. banaticus, *Kern.*)

h^2. surulis, *mihi, Enum. spp. varr. Dianthus*, p. 11; *Pinks Cent. Eur.* p. 14, t. ii.

Glaber, 30 centim. Folia 35 mm. rigida, subfloralia obovato-lanceolata. Capitulum pauciflorum, floribus 4–6. Bracteæ

obovatæ ventricosæ stramineæ, apice rectæ. Calyx basi viridis, dentibus acuminatis. Lamina supra purpurea, subtus pallidior. —*Herb. Kew. ex Herb. Schott*, no. 447.

Hab. Mt. Surul in S. Transylvania, alt. 1560 metres (d. 16 June, 1850).

Grex sanguinei.—Glaber, glaucus. Folia linearia, vagina folii diam. 4-plo longiore. Capitulum densissime multiflorum; floribus minimis 20–30. Calycis dentes subulato-acuminati. Lamina = ½ unguis.

*i*². sanguineus, *Vis.* (sp.) *Ind. sem. Hort. Patav.* 1845, p. 1; *Fl. Dalmatica*, iii. p. 161, t. 36; *Reichb. Icon. Fl. Germ. Helv.* 5016 *b*.

38 centim. Capitulum hemisphæricum. Bracteæ oblongo-ovales non ventricosæ. Calyx basi virescens sursum purpureo-fuscus, dentibus ciliatis. Lamina sanguinea, supra viridi-punicea, subtus atrorubra.

*j*². consanguineus, *Schur* (sp.), *Enum. Pl. Transsilvaniæ*, p. 93; *auct. Pinks Cent. Eur.* p. 15.

45 centim. Capitulum conglobatum. Bracteæ coriaceæ non ventricosæ, interiores obovatæ, exteriores oblongæ. Calyx purpureus punctulato-scabridus, dentibus lævibus. Lamina atrosanguinea, oblongo-clavata.

Geogr. limits.—*N.* Denmark, 55°. *E.* Ural, 49°.
S. Egypt, 28°. *W.* N. Portugal, 8°.

Of this species so many forms have been described, both as species and as varieties (chiefly by Austro-Hungarian botanists), in multitudinous scientific serials and the publications of learned societies, that it has frequently happened that the same plant has been described more than once under different auspices; consequently the labour of disentangling the synonymy has been considerable. As in the case of all polymorphic species with a wide distribution, there is a considerable divergence of opinion as to the definite circumscription of individual forms in the varying degrees of subspecific types. The tendency to over-discrimination or to imperfect appreciation of differences is entirely a personal one. Under these circumstances, I have thought it desirable to describe more fully the several varieties, associated into "greges" according to their apparent affinities both among themselves and in their relation to the species.

For the purpose of comparing how the minor specific cha-

racters are amplified in later and fuller descriptions of the species in order to emphasize differential characters in well-marked varieties, Linnæus' original description is here transcribed from 'Hort. Upsaliensis,' p. 105 :—

"Radix vivax. Caulis erectus, firmus. Folia lato-lanceolata, margine (cartilagineo serrato) scabro. Flores subaggregati primoribus sessilibus. Foliola calycina ovata in acumen lineare acuminatum longitudine tubi desinentia, subfusca, patentia : hinc calyces squarrosi. Petala rubra, crenata, lateribus reflexa, circa centrum obscurius rubra. Antheræ cæruleæ. Folia inferne caulem non vaginantia."

The rootstock is much branched, and the barren shoots are vigorous, numerous, and foliose, thus giving the plant a cæspitose habit. The stems are almost invariably smooth but not shining, angular and unbranched, unless it may be at the very base, where two branches may spring almost together from the crown. In *D. Schlosseri* and *cruentus* the stems are terete. The leaf-sheath is very long, as in *D. ambiguus*. The bracts, unlike those of *D. barbatus*, are broad and mucronate. The calyx is constricted at the base of the teeth, and this character further distinguishes it from *D. slavonicus* and *Borbasii*; the teeth are 9-nerved, and in this character differs from *D. pelviformis*. The petals, as might be expected, vary much in tint, from dark purple to rose-coloured and white, and the dentation is irregular. They do not vary so much in length as in the proportion of lamina to unguis. Linnæus makes the curiously erroneous statement that *D. barbatus* differs from this species in having 1-nerved instead of 3-nerved leaves; whereas both species agree in having 5-nerved leaves, though the two lateral nerves are obscure.

36. D. Knappii, *Aschers. et Kan. in Bot. Zeitung*, 1876, p. 355 ; *auct. Pinks Cent. Eur.* p. 18.

Glaucus, scaber, 35 centim. Folia lineari-lanceolata acuminata 3-nervia carinata, vagina folii diam. 3-plo longiore. Bracteæ 4 mucronatæ ad dimidium calycem coriaceæ. Calyx apice attenuato, dentibus acuminatis. Lamina supra cinnabarina, infra sulphurea. Antheræ cæruleæ.

b. rosulatus, *Borb.* (sp.) *in Bot. Zeitung*, 1876, p. 356 ; *auct. Pinks Cent. Eur.* p. 18.

Glaucissimus, foliosus. Caulis superne teres. Folia basi non

attenuata. Capitulum 6–9 florum. Bracteæ oblongæ. Lamina $=\frac{1}{2}$ unguis. (=D. liburnicus, *Porta.*)

c. humilis, *Brügg in Herb. Kew.* (=D. Carthusianorum, *var.*); *auct. Pinks Cent. Eur.* p. 19.

10 centim. Caulis angulatus, foliis 10 mm. linearibus rigidis. Capitulum 3 florum pallidissimorum. Bracteæ elliptico-oblongæ ventricosæ. Lamina $=\frac{1}{2}$ unguis.

Geogr. limits.—*N.* Hungary, 48°. *E.* Banat, 22°.
S. Apulia, 40°. *W.* Herzegovina, 18°.

Differs from the preceding species in not being cæspitose, and in having very rough stems with grooved and strongly-keeled leaves, and only 3 or 4 flowers on each head. I am unable to refer to the original publication of this species; but it is here described from a specimen in Herb. Mus. Brit., and Borbas gives a good diagnosis of it (*loc. cit.*).

37. D. AMBIGUUS, *Panč. Fl. Princip. Serbiæ*, p. 178; *auct. Pinks Cent. Eur.* p. 19.

Glaber. Caules simplices 4-angulares. Folia 50 mm., elongato-linearia acuminata plana 3-nervia patentia, vagina folii diam. 4-plo longiore. Inflorescentia capitulis densis 22–28 florum. Bracteæ 4 ad calycis apices mucronatæ, patentes. Calyx purpureus, dentibus acuminatis 9-nerviis. Petala contigua; lamina purpurea, $=\frac{1}{3}$ unguis.

Hab. Servia and Bulgaria.

38. D. SCHLOSSERI, *mihi, in Journ. of Botany*, 1885, p. 342, *et Enum. spp. varr. Dianthus* (1889), p. 11; *Pinks Cent. Eur.* p. 19.

Glaber. Caules 45 centim., teretes simplices. Folia elongato-linearia acuminata plana 3-nervia adpressa, vagina folii diam. duplo longiore, radicalia 100 mm., caulina 70 mm. Flores capitati. Bracteæ 6, obovatæ adpressæ mucronatæ ad $\frac{1}{3}$ calycis partem. Calyx purpureus, apice attenuato.

Hab. Croatia.

Described from C. J. Schlosser's specimens in Herb. Mus. Brit., found near Samobor, in the territorial district of Agram. The plant is certainly distinct from any of the forms of *D. Carthusianorum*, and differs from *D. pelviformis* in the terete stems, shorter leaf-sheath and bracts, and dark red calyx-tube. *D. cruentus* differs from it in its cæspitose, glaucous habit and in its

roader leaves which are 5–7-nerved, and patent the apex. This may possibly be the same plant orb.

ous, *mihi* (=D. atrorubens, *Kit. in Linnæa*, *uct. Pinks Cent. Eur.* p. 20).

ber, viridis. Caulis 44 centim., erectus tetragonus simplicissimus. Folia linearia acuta 5-nervia plana patentia, vagina folii diam. 4-plo longiore, radicalia 72 mm. interdum 7-nervia (nervis 2 marginalibus obsoletis), caulina 60 mm., subfloralia 4 ovata cuspidata capitulo longiora. Capitulum multiflorum, floribus atrorubentibus 8–14. Bracteæ 4, oblongæ planæ, basi subherbaceæ tunc rubello-scariosæ, mucronatæ ad dimidium calycem. Calyx dentibus acuminatis. Petala contigua; lamina $=\frac{1}{2}$ unguis.

Hab. Slavonia.

This species was referred by Kitaibel to that limbo of critical forms, *D. atrorubens*, All.; but it certainly appears to differ essentially from the classical descriptions of the plant. Found at Essek on the banks of the Drave, in Slavonia.

40. D. PELVIFORMIS, *Heuff. in Flora*, 1853, p. 625.

Glaber. Caules 55 centim., 4-angulares simplices. Folia 52 mm., elongato-linearia acuminata 3–5-nervia plana, vagina folii diam. 3-plo longiore. Inflorescentia capitulis densis 24–26 florum. Bracteæ 6 obovato-rotundatæ mucronatæ adpressæ ad dimidium calycem. Calyx apice attenuato, dentibus acuminatis purpureis 7-nerviis. Lamina purpurea, $=\frac{1}{2}$ unguis.

Hab. Servia.

41. D. CRUENTUS, *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 186; *auct. Pinks Cent. Eur.* p. 20.

Cæspitosus, glaucus, glaber. Caules 50 centim., furcati teretes. Folia acuminata plana; radicalia 100 mm. lineari-lanceolata patentia 7-nervia infra rubella, caulina linearia adpressa 5-nervia, vagina folii diam. 4-plo longiore; subfloralia mucronata calycem excedentia. Inflorescentia subglobosa dense capitata circiter 20 florum inodororum. Bracteæ 6, obovatæ mucronatæ ad dimidium calycem patentes. Calyx rubellus apice attenuato, dentibus acuminatis margine scabridis. Petala rubella non contigua; lamina $=\frac{1}{2}$ unguis. Antheræ cæruleæ. Capsula cylindrico-oblonga.

b. fastigiatus, *Pantoč* (sp.), *Adnotat.* p. 105; *Borb. Symb. Caryoph. Melanth. Fl. Croat.* p. 12.

32 centim. Caulis apice in cymam trifasciculatam longissimam divisus. Calyx 10–12 mm.

Geogr. limits:—

N. Servia, 44°.	*E.* Rumelia, in Turkey, 27°.
S. Mt. Olympus, in Thessaly, 40°.	*W.* Herzegovina, 18°.

42. D. LYDUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 20; *Fl. Orient.* i. p. 543.

Hispidus, 45 centim. Caules simplices, 4-angulares. Folia elongato-linearia acuminata patentia 3-nervia carinata; radicalia 57 mm. recurva, caulina 50 mm. incurva, vaginâ folii diam. 6-plo longiore, subfloralia pallide rufescentia breviter aristata. Flores 6–8 in capitulo, dense aggregati. Bracteæ 4 rufescentes, obovato-lanceolatæ patentes, mucronulatæ ad calycis apices. Calyx rubellus apice attenuato, dentibus acutis subpungentibus. Petala contigua; lamina rosea, $=\frac{1}{3}$ unguis.

Hab. Lydia, Phrygia, and Caria, in Asia Minor.

43. D. LILACINUS, *Boiss. et Heldr. Diagn. Pl. Nov. Or.* ser. II. i. p. 63; *Fl. Orient.* i. p. 514.

Scabridus, cæspitosus. Caudices suffrutescentes. Caules 60 centim., tenues flexuosi 4-angulares. Folia 63 mm., setaceo-linearia acuta 3-nervia plana, radicalia patentia recurva, caulina adpressa, vaginâ folii diam. 4-plo longiore, subfloralia lanceolato-linearia capitulum æquantia. Inflorescentia in capitulis fastigiatis 4–6 florum inodororum. Bracteæ 4 lanceolatæ acuminatæ ad calycis apices, patentes rufescentes. Calyx purpureus, dentibus acuminatis. Petala contigua; lamina lilacina, $=\frac{1}{3}$ unguis. Antheræ cæruleæ peltatæ. Capsula ovoidea.

b. androsaceus, *Boiss. et Heldr. Fl. Orient., Suppl.* p. 81; *Nym. Consp. Fl. Eur., Suppl.* ii. p. 59.

Dense cæspitosus. Caules 4 centim. flexuose nodosissimi. Folia pungentia. Flores subsessiles.

Hab. Livadia, in Greece.

44. D. BARBATUS, *Linn. Sp. Plantarum,* ed. I. p. 409; *Reichb. Fl. Germ. Excurs.* p. 804; *Ic. Fl. Germ. Helv.* f. 5013.

Glaber. Caules 50 centim., simplices v. superne ramosi

tetragoni. Folia lanceolata acuta plana 5-nervia; radicalia 44 mm., vagina folii diam. duplo longiore, caulina 30 mm., vagina folii diam. æquante, subfloralia lanceolato-linearia. Inflorescentia fastigiis fasciculorum regulariter trichotomorum, floribus densis brevissime pedicellatis inodoris. Bracteæ 4 lanceolatæ acuminatæ ad calycis apices. Calyx viridis v. rubescens apice attenuato, dentibus acuminatis. Petala contigua; lamina $= \frac{1}{3}$ unguis. Capsula oblonga. Semina granulata.

b. latifolius, *Ser. in DC. Prodr.* i. p. 356; *auct. Pinks Cent. Eur.* p. 21.

Folia latiora. Inflorescentia fasciculis simpliciter trichotomis.

c. aggregatus, *Poir. Encyc., Supplem.* iv. p. 124; *Ser. in DC. Prodr.* i. p. 356; *Sweet, Fl. Gard.* ii. t. 166.

Asperiusculus. Flores capitulis aggregatis. Bracteæ calycem superantes.

d. rariflorus, *Schur, Enum. Pl. Transsilvaniæ*, p. 92; *auct. Pinks Cent. Eur.* p. 21.

Flores non dense aggregati. Bracteæ breviores. Petala pallide rosea.

Geogr. limits:—

N. Moscow (prov.), 55°. *E.* China, 120°.
S. N. China, 35°. *W.* Republic of Andorra, 2°.

Rohrbach sinks in this species Thunberg's *D. japonicus* (see no. 28); but *D. barbatus* differs from it in the following points:—Stems 4-angular, and sometimes branched above; leaves lanceolate, plane, and not contorted at the base, 5-nerved; sheath of the radical leaves twice as long as broad; fascicles fastigiate; flowers of a darker red, denser, and consequently on shorter pedicels; bracts very scarious, lanceolate, as long as the calyx; calyx contracted at the base of the purple teeth; petals broader, obovate-cuneate; and capsule oblong,—so that they seem as different as any two pinks can well be. An experiment of Darwin's further illustrates the distinction. In his investigations into the power of mutual cross-fertilization of the commoner pinks, he found that if the flower of *D. barbatus* were fertilized by the pollen of *D. superbus* it yielded a proportional 81 seeds, when fertilized by the pollen of *D. japonicus* a proportional 66 seeds, relatively to the 100 seeds produced by its own pollen. There seems a discrepancy in various descriptions of the species as to whether the petals are bearded or not. I have followed Reichenbach

both in the text, where he speaks of "petalis barbatis," and in the figure cited for the plant. Moreover, in certain cultivated forms the bearded condition of the petals tends to disappear. In var. *aggregatus*, which is certainly to be referred to this species, Sweet says "the limb is of a bright crimson when first expanded, afterwards changing to a dark purple, and marked towards the base with a darker irregular patch, bearded with a few long scattered hairs." Besser described a *D. pseudobarbatus*, referred to by Ledebour (Fl. Rossica, i. p. 277); but his own specimens, which are at Kew, seem to have been incorrectly described originally, and do not differ anywise from *D. barbatus* itself.

45. D. SUBBARBATUS, *Schur, Enum. Pl. Transsilvaniæ*, p. 92; *auct. Pinks Cent. Eur.* p. 23.

Glaber. Caules 55 centim., interdum recumbentes, ramosi tetragoni. Folia suboblonga acuta 5-nervia plana patentia, radicalia 42 mm., reliqua 30 mm., vagina folii diam. duplo longiore, subfloralia interdum reflexa. Inflorescentia subfastigiato-capitata floribus speciosis pallide purpureis. Bracteæ 4 lanceolatæ acuminatæ ad calycis apices. Calyx apice attenuato, dentibus acuminatis. Petala contigua; lamina $=\frac{1}{3}$ unguis. Capsula oblonga. Semina peltata tenuiter reticulata, margine scabrida.

Hab. County of Bistritz, in Transylvania.

46. D. DIUTINUS, *Kit. in Schultes, Oesterreichs Flora*, ed. II. i. p. 655; *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 186; *Reichb. Ic. Fl. Germ. Helv.* f. 5017 (D. polymorphus).

Glaber. Caules 36 centim., simplices tetragoni. Folia 77 mm., linearia acuminata carinata patentia, vagina folii diam. 4-plo longiore. Inflorescentia capitulis aggregatis 6–8 florum. Bracteæ 4 obovato-lanceolatæ mucronulatæ ad dimidium calycem patentes. Calyx apice attenuato, dentibus acuminatis. Petala contigus; lamina pallide rubra, $=\frac{1}{3}$ unguis.

Geogr. limits.—*N.* North Hungary. *E.* The Banat.
S. Servia. *W.* Croatia.

The authors of some of the Austrian floras have joined this species with *D. polymorphus* considering them as identical; but, as Boissier points out, they are very distinct plants. Its affinity with *D. stenopetalus* is much more marked.

47. D. BORBASII, *Vandas, in Oesterr. Bot. Zeitschr.* 1886; *auct. Pinks Cent. Eur.* p. 23.

Glaber. Caules 45 centim., simplices tetragoni inferne as-

peruli. Folia elongato-linearia carinata trinervia acuminata, vagina caulis diam. 6-plo longiore, subfloralia anguste oblonga. Inflorescentia capitulis 2–7 florum, infra bifasciculata. Bracteæ 4 pallidæ marginaliter brunneæ, ellipticæ. Calycis dentes acuminati purpurei 11-nervii. Lamina purpurea, $=\frac{1}{3}$ unguis.

Hab. Galicia, in Austria; and Volhynia, in Russia.

48. D. CAPITATUS, *Balb. in DC. Cat. Hort. Monspeliensis*, 1813, pp. 24, 103; *Boiss. Fl. Orient.* i. p. 514; *Reichb. Ic. Fl. Germ. Helv.* 5015.

Glaucus, lanatus. Caules 35 centim., simplices tetragoni. Folia linearia acuta plana patentia, radicalia 72 mm. 7-nervia, caulina 50 mm. 5-nervia, vagina folii diam. 4-plo longiore ventricosa in limbum ampliata, subfloralia late ovata capitulum subæquantia. Inflorescentia capitulis aggregatis 6–8 florum. Bracteæ 4 obovatæ mucronulatæ calycem superantes patentes. Calyx purpureus apice attenuato, dentibus acutis. Petala contigua; lamina purpurea maculata, $=\frac{1}{2}$ unguis.

b. minor, *Boiss. Fl. Orient.* i. p. 514; *Kanitz, Pl. Romaniæ*, p. 183.

Capitula minora.

c. Pancicianus, *mihi*, *ex Panč. Elem. Fl. Princip. Bulgariæ* (1883); *auct. Pinks Cent. Eur.* p. 24.

Varietas innominata: glabra foliis acuminatis, petalis purpureis.

Geogr. limits.—*N.* Siberia. *E.* Siberia.
S. Bulgaria. *W.* Servia.

** Dentes calycis mucronati.

49. D. INTERMEDIUS, *Boiss. Fl. Orient.* i. p. 515; *auct. Pinks Cent. Eur.* p. 21; *Sibth. Fl. Græca*, t. 392 (D. Carthusianorum).

Cæspitosus, glaber, 60 centim. Caules simplices tetragoni. Folia 63 mm., linearia acuta 5-nervia plana, vagina folii diam. 4-plo longiore, radicalia patentia recurva, caulina adpressa, subfloralia oblongo-lanceolata fuscescentia. Inflorescentia capitulis fastigiatis 4–6 florum inodororum. Bracteæ 4 lanceolatæ acuminatæ ad dimidium calycem adpressæ. Calyx purpurascens. Petala contigua; lamina rosea, $=\frac{1}{3}$ unguis. Capsula ovoidea.

Geogr. limits.—*N.* Bosnia, in Austria. *E.* Anatolia.
S. Thessaly, in Greece. *W.* Bosnia, in Austria.

Subsectio 3. *Macrolepides.*

Bracteæ 4, ovatæ patentes.

* Involucri phylla scariosa, rarius herbacea. Petala barbulata.

50. D. COMPACTUS, *Kit. in Schultes, Oesterreichs Fl.* ed. II. i. p. 654; *Reichb. Fl. Germ. Excurs.* p. 805.

Glaber. Caules 50 centim., simplices v. superne ramosi teretes. Folia plana lanceolata acuta 5-nervia patentia recurva, radicalia 44 mm. vagina folii diam. duplo longiore, caulina 30 mm. vagina folii diam. æquante. Inflorescentia fasciculis trichotomis florum densorum inodororum. Bracteæ purpureo-brunneæ acuminatæ ad calycis apices. Calyx rubellus apice attenuato, dentibus acutis triangularibus. Petala contigua; lamina purpurea obovato-cuneata maculata, $=\frac{1}{2}$ unguis.

b. prelucianus, *mihi*, ex *Növenytani Lapok* (1885), p. 126; *Pinks Cent. Eur.* p. 25.

Calyx viridis. Lamina pallidissima.

A variety with much paler flowers, found by F. Porcius near Preluci in the county of Naszod in Hungary.

Geogr. limits.—*N.* Galicia, in Austria, 49°. *E.* Wallachia. *S.* Mt. Majella, in Abruzzi, 42°. *W.* Carniola.

51. D. CRASSIPES, *Roem. ap. Willk. Icon. Descr. Pl. Crit.* i. p. 7, t. 1; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 677.

Pubescens. Caules 58 centim., simplices teretes stricti. Folia stricta adpressa; basilaria 62 mm., 7-nervia acuta, reliqua 50 mm., 5-nervia acuminata, vagina folii diam. duplo longiore, subfloralia elliptica late membranacea capitulum superantia. Inflorescentia corymbosa, fasciculis plerumque 2 pedunculis angulatis; capitulis 20–30 florum inodororum. Bracteæ 2 exteriores ad dimidium calycem acutæ, 2 interiores ad calycis apices acuminatæ. Calyx apice attenuato, dentibus lanceolatis acuminatis. Petala non contigua; lamina obovato-cuneata purpurea, $=\frac{1}{3}$ unguis. Semina punctulata.

Hab. Andalusia.

52. D. GIRARDINI, *Lamotte in Bull. Soc. Bot. France,* 1874; *auct. Pinks West. Eur.* p. 13.

Glaber. Caules 50 centim., simplices v. superne ramosi teretes. Folia 35 mm., lanceolata acuminata plana mollia 5-nervia, vagina folii diam. æquante, subfloralia lanceolato-linearia.

Inflorescentia cymis regulariter trichotomis; floribus laxis inodoris. Bracteæ mucronulatæ ad calycis apices. Calyx dentibus lanceolatis acuminatis purpureis. Petala contigua; lamina purpurea maculata, $=\frac{1}{2}$ unguis. Antheræ violaceæ. Capsula oblonga dentibus obtusis.

Hab. Central France.

53. D. ASPERULUS, *Boiss. et Huet, in Boiss. Diagn. Pl. Nov. Or.* ser. II. v. p. 51; *Boiss. Fl. Orient.* i. p. 510.

Minute pruinoso-asperulus, 25 centim. Caules simplices tetragoni foliosi. Folia viridia flaccida carinata 3-nervia (nervis lateralibus obscurioribus) linearia, inferiora 36 mm. patentia obtusa, cetera 21 mm. adpressa acuta, vagina folii diam. duplo longiore; involucri phylla lineari-lanceolata, flores æquantia, scariosa. Flores 4–6 in capitulum dense congesti. Bracteæ mucronulatæ ad calycis apices stramineæ. Calyx apice attenuato, dentibus rubellis ovatis mucronulatis ciliolatis 11-nerviis. Petala concoloria; lamina rubra oblonga, $=\frac{1}{3}$ unguis.

Geogr. area.—Turkish Armenia.

54. D. COLLINUS, *Waldst. et Kit. Pl. Rar. Hung.* i. p. 36, t. 38; *Reichb. Fl. Germ. Excurs.* p. 805; *Ic. Bot. Pl. Crit.* n. 739.

Glaucus, minute lanatus. Caules 40 centim., teretes, interdum superne subangulati. Folia 36 mm., linearia acuta 3–5-nervia (nervis lateralibus obscurioribus) stricta plana, vagina folii diam. æquante; involucri phylla subulata adpressa fasciculo breviora. Inflorescentia fasciculis capitatis 3–5 florum. Bracteæ stramineæ acuminatæ ad dimidium calycem. Calyx apice attenuato, dentibus rubris lanceolatis acuminatis. Petala obovato-cuneata; lamina purpurea, $=\frac{1}{2}$ unguis.

b. subpaniculatus, *Schur, Enum. Pl. Transsilvaniæ*, p. 96; *auct. Pinks Cent. Eur.* p. 26.

Hirtule scaber. Flores fastigiato-paniculati, plurimis dissitis et solitariis. Bracteæ calycem subæquantes.

This variety is founded on a specimen in Lerchenfeld's Transylvanian herbarium, dated 1780.

c. sylvaticus, *Hoppe* (sp.) *in Sturm, Deutsch. Fl.*, Heft 28; *Gren. et Godr. Fl. de France,* i. p. 233; *Reichb. Ic. Fl. Germ. Helv.* f. 5023 (D. Seguieri).

Caules subangulati. Folia lineari-lanceolata mollia viridia. Flores ternato-fasciculati. Calyx fuscus, dentibus acutis. Petala contigua; lamina oblongo-cuneata.

d. imereticus, *Rupr. Fl. Caucasi*; *auct. Enum. spp. varr. Dianthus*, p. 12.

Glaber. Inflorescentia fasciculis florum parvorum.

Occurs in the province of Imeretia, in Trans-Caucasia.

Geogr. limits.—*N.* Galicia, in Austria. *E.* Caucasus.
S. Asia Minor. *W.* E. Pyrenees.

This species, which is very difficult to define and circumscribe, together with the European form of *D. sinensis* (*D. Seguieri*, Vill.), may be considered as the connecting links between the two natural divisions of the genus, viz., the one in which the stems and their branches bear small clustered flowers, and the one in which they bear large single flowers. The stem terminates in a single head of flowers, or branches into dichotomous fascicles; or more rarely the flowering branch may be trifasciculate. When an irregular third fascicle is present, it grows from the axils of the uppermost leaves and overtops the other two.

55. D. HYMENOLEPIS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. viii. p. 64; *Fl. Orient.* i. p. 510.

Puberulus, 25 centim. Caules simplices tetragoni. Folia 36 mm., linearia acuminata plana, inferiora patentia 5-nervia, cetera adpressa 3-nervia, vagina folii diam. duplo longiore; involucri phylla rubella oblongo-linearia aristata ad capituli apices. Flores 2–4-capitati. Bracteæ stramineæ mucronulatæ ad calycis apices purpureo-marginatæ. Calyx oblongus, dentibus ovatis obtusis rubellis. Lamina rosea subcuneata maculata, $=\frac{1}{3}$ unguis.

Hab. Mesopotamia.

56. D. POLYMORPHUS, *Bieb. Fl. Taur.-Cauc.* i. p. 324; *Boiss. Fl. Orient.* i. p. 511; *Reichb. Ic. Bot. Pl. Crit.* n. 730.

Glaber. Caules 30 centim., teretes apice ramosi. Folia 52 mm., elongato-linearia acuminata carinata trinervia patentia stricta, vagina folii diam. triplo longiore; involucri phylla bracteis similia. Inflorescentia capitulis aggregatis 4–8 florum inodororum. Bracteæ stramineæ mucronatæ ad $\frac{1}{3}$ calycis. Calyx rubellus, dentibus ovatis obtusis ciliolatis 9-nerviis. Petala contigua; lamina subtricrenata rosea obovato-cuneata, $=\frac{1}{2}$ unguis. Antheræ pallidæ.

Geogr. limits.—*N.* Pensa, in Russia, 53°.
S. Kladovo, in Servia, 44°.
E. Orenburg, in Russia, 55°.
W. Upper Austria, 15°.

57. D. GLABRIUSCULUS, *Kit. sec. Kanitz, in Linnæa* (1863), p. 526; *auct. Pinks Cent. Eur.* p. 27.

Glaber, 45 centim. Folia lineari-lanceolata acuta 5-nervia plana; radicalia 72 mm., vagina caulis diam. duplo longiore, caulina 50 mm., vagina caulis diam. æquante. Inflorescentia fasciculis dichotomis 12 florum. Bracteæ stramineæ acuminatæ ad dimidium calycem. Calyx dentibus lanceolatis acuminatis. Lamina carnea.

Hab. Hungary.

58. D. PSEUDOBARBATUS, *Schur, Enum. Pl. Transsilvaniæ*, p. 96; *auct. Enum. spp. varr. Dianthus*, p. 12.

Glaber, 45 centim. Folia linearia acuta 5-nervia plana; radicalia 72 mm., vagina caulis diam. duplo longiore, caulina 50 mm., vagina caulis diam. æquante. Inflorescentia fasciculis trichotomis 12 florum. Bracteæ mucronatæ ad calycis apices. Calyx dentibus lanceolatis acuminatis. Lamina obovato-cuneata rosea.

Hab. Transylvania.

This species differs from the preceding chiefly in the narrower leaves, in the long mucronate bracts, and in the trichotomously disposed fascicles.

59. D. TOLETANUS, *Boiss. et Reut. Diagn. Pl. Nov.* no. 8; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 680; *Willk. Icon. Descr. Pl. Crit.* i. p. 19, t. 11.

Suffrutescens, glaucus, scaber. Caules 25 centim., stricti furcati tetragoni. Folia linearia acuta stricta plana adpressa; radicalia 24 mm. 5-nervia basi valde dilatata, caulina 20 mm. 3-nervia, summis abbreviatis, vagina folii diam. æquante. Flores subfasciculati fere sessiles cymis laxis. Bracteæ mucronatæ ad dimidium calycem, subherbaceæ. Calyx rubellus apice attenuato, dentibus mucronatis 11-nerviis. Petala non contigua; lamina obovato-cuneata supra purpurea subtus pallida, $=\frac{1}{2}$ unguis. Antheræ cæruleæ.

Geogr. limits.—*N.* Cantabrian Mountains, 43°.
S. Sierra Morena, 36°.
E. Eastern boundary of prov. of Castile, 2° W.
W. Sierra d'Estrella, in Portugal, 8° W.

60. D. TRISTIS, *Velen. in Sitzungsb. Boehmisch. Gesellsch. Wissensch.* 1890, p. 41.

Cæspitosus, glaber. Caules 20–40 centim., simplices tetragoni.

Folia flaccida; rosularia elongato-linearia, reliqua lanceolato-linearia 5–7-nervia plana acuminata, vagina folii diam. 3–4-plo longiore; involucri phylla scariosa fusca lanceolato-elongata capitulum subæquantia. Flores capitati. Bracteæ scariosæ fuscæ mucronatæ ad dimidium calycem. Calyx dentibus lanceolatis. Lamina obovato-cuneata, $=\frac{1}{2}$ unguis.

Hab. Bulgaria.

** Involucri phylla et bracteæ scariosa. Petala imberbia.

61. D. CINNABARINUS, *Sprun. in Boiss. Diagn. Pl. Nov. Or.* ser. I. vi. p. 22; *Boiss. Fl. Orient.* i. p. 511.

Glaber, multicaulis, basi suffrutescens, 13 centim. Caules simplices tetragoni. Folia 77 mm., plana stricta patentia pungentia; basilaria linearia acuta 7-nervia, reliqua elongato-linearia acuminata 5-nervia, vagina folii diam. 3–4-plo longiore; involucri phylla basi dilatata lineari-setacea aristata rubella. Flores capitulis paucifloris. Bracteæ rubescentes mucronatæ ad dimidium calycem. Calyx apice attenuato, dentibus lanceolatis acuminatis. Petala contigua; lamina maculata supra cinnabarina subtus flavida, obovato-cuneata.

b. alpinus, *Boiss. Fl. Orient.* i. p. 511; *Nym. Consp. Fl. Eur.* p. 103; *Sibth. Fl. Græca*, t. 393 (D. biflorus).

Caules breviores. Lamina cinnabarina vel purpureo-rosea.

Hab. Greece.

62. D. STENOPETALUS, *Griseb. Spicil. Fl. Rumel. Bithyn.* i p. 187; *Boiss. Fl. Orient.* i. p. 513.

Cæspitosus, glaber, 30 centim. Caules tenues tetragoni. Folia linearia acuminata 3-nervia flaccida; radicalia 50 mm., recurva carinata, vagina folii diam. 3-plo longiore, reliqua 26 mm. stricta plana, vagina folii diam. 4-plo longiore; involucri phylla basi dilatata aristata fusco-rubescentia. Inflorescentia cymis paniculatis 5–15 florum. Bracteæ stramineæ mucronatæ ad calycis apices. Calyx atropurpureus apice attenuato, dentibus lanceolatis acuminatis. Petala non contigua; lamina purpurea lineari-oblonga, $=\frac{1}{3}$ unguis.

b. Pancicii, *Velen.* (sp.) *in Abhandl. Boehmisch. Gesellsch. Wissensch.* 1886; *Nym. Consp. Fl. Eur., Suppl.* ii. p. 59.

Calyx viridis. Lamina rosea.

Geogr. limits.—N. Bulgaria. *S.* Thessaly, in Greece.

*** Involucri phylla herbacea. Calyx verruculosus. Petala barbulata.

63. D. BITLISIANUS, *Boiss. Fl. Orient.* i. p. 483.

Caules 13 centim., ramosi tetragoni. Folia brevissima linearia acuminata patentia. Bracteæ mucronatæ ad dimidium calycem. Calyx dentibus ovatis mucronatis ciliolatis. Petala contigua; lamina obovato-cuneata rosea subtus virente.

Hab. Bitlis, in the province of Musch; Gornja Voda, in Albania.

Subgenus II. CARYOPHYLLASTRUM.

Caudex perennis, herbaceus, breves turiones steriles decumbentes, numerososque foliososque, atque caules floriferos adscendentes, emittens. Folia subfloralia vere bracteiformia nulla, interdum 2 summis herbaceis abbreviatis nunquam subscariosis. Flores in caule ramulisve solitarii, vel geminati vel rarius terni longissime pedunculati. Calyx cylindricus valde striatus. Petala dentata integra vel fimbriata, rarissime retusa. Torus elongatus in gynophorum stipitiforme.

Sectio 1. FIMBRIATUM.

Bracteæ 4–16. Petala fimbriata.

Subsectio 1. *Plumarioides.*

Caules teretes. Calycis dentes mucronati. Petala barbulata, non contigua.

64. D. PLUMARIUS, *Linn. Sp. Plantarum*, ed. I. p. 411; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 687; *Reichb. Ic. Fl. Germ. Helv.* 5030*.

Cæspitosus, glaber, glaucus, 30 centim. Caules simplices v. superne furcati 2–5-flori. Folia elongato-linearia acuta carinata patentia recurva uninervia crassiuscula; radicalia 100 mm., caulina 48 mm., vagina folii diam. duplo longiore. Flores rosei odorati speciosi dimorphici cyma laxa irregulari. Bracteæ 4, interiores obovatæ, exteriores obovato-lanceolatæ, mucronatæ ad $\frac{1}{4}$–$\frac{1}{3}$ calycis

* I should have preferred to have cited the plate from 'English Botany'; but, by an unworthy act on the part of the publishers, the plate is transferred from its proper sequence to another part of the issue, as is the case with plates of other species, apparently in order to discourage the purchase of separate parts of an expensive work.

partem. Calyx basi obsolete striatus apice attenuato, dentibus triangularibus 9–11-nerviis. Petala ad medium digitato-multifida, area intermedia obovata, lamina = $\frac{1}{2}$ unguis. Antheræ pallidæ. Capsula cylindrica.

b. albiflorus, *Schur, Enum. Pl. Transsilvaniæ*; *Reichb. Icon. Fl. Germ. Helv.* 5030 (D. hungaricus).

c. roseoflorus, *Schur, Enum. Pl. Transsilvaniæ*; *Reichb. Icon. Fl. Germ. Helv.* 5030 *b* (D. blandus).

d. perramosus, *Schur, Enum. Pl. Transsilvaniæ*; *Reichb. Icon. Fl. Germ. Helv.* f. 5029 *b* (D. hortensis, *Schrad.*).

Geogr. limits.—*N.* Prov. of Volhynia, in Russia.
E. Along the river Ischin, in Siberia.
S. Croatia.
W. The cliffs of Rabenstein in Carinthia, Austria.

As this pink is so commonly cultivated, it has established itself and become more or less naturalized in various localities in different countries. Like *D. Caryophyllus*, it is only very locally distributed, and is recorded in many floras not as an indigenous species, but as one that having been long established has become quite naturalized.

65. D. ARENARIUS, *Linn. Sp. Plant.* ed. I. p. 412; *Ledeb. Fl. Rossica*, i. p. 284; *Reichb. Icon. Fl. Germ. Helv.* 5026.

Cæspitosus, glaber, 10 centim. Caules simplices v. superne furcati, graciles, 1–3-flori. Folia elongato-linearia carinata, radicalia 14 mm. fasciculata patentia obtusa, caulina 12 mm. stricta adpressa acuta, vagina folii diam. æquante. Flores albi odorati. Bracteæ 4, obovatæ mucronatæ ad $\frac{1}{4}$–$\frac{1}{3}$ calycis partem adpressæ, stramineæ. Calyx purpureus apice attenuato, dentibus ovato-lanceolatis. Petala ultra medium pinnatifido-multipartita, area intermedia oblonga maculata, lamina = $\frac{1}{3}$ unguis. Antheræ pallidæ. Capsula cylindrica.

b. glaucus, *Blocki, in Oesterr. Bot. Zeitschr.* 1884, p. 250.

This glaucous variety forms the connecting link between the two species. Linnæus distinguishes the two by their petals. Of this species he writes:—"affinitatem hujus summam cum præcedente docet petalorum faux; petala magis oblonga, divisa et lacera ultra medium disci (illi vero tantum multifida), basi macula livida acuta, pilis purpurascentibus adspersa."—*Sp. Pl.* ed. II. p. 589.

Geogr. limits.—*N.* Finland (near Lake Saima), 61°.
S. Dalmatia (Mt. Promina), 44°.
E. Lake Baikal, in W. Siberia, 126°.
W. Hanover, 11°.

66. D. Oreadum, *Hance, in Ann. Sci. Nat.* (*Bot.*) sér. V. v. 1866, p. 207; (*Herb. Hance*, no. 1720).

Glaber, 100 centim. Folia lanceolata acuta stricta, radicalia 150 mm., caulina 125 mm., vagina folii diam. æquante. Flores laxe cymosi odorati. Bracteæ 8, oblongo-ovatæ adpressæ mucronatæ ad $\frac{1}{3}$ calycis. Calyx purpurascens apice attenuato. Lamina obovato-cuneata.

Hab. South China.

Subsectio 2. *Schistostolon.*

Caules ramosi, glabri. Calycis dentes acuminati.

* Caules teretes. Folia 3–5-nervia. Bracteæ acuminatæ adpressæ scarioso-alatæ. Calycis dentes lanceolati.

67. D. monspessulanus, *Linn. Sp. Plantarum*, ed. II. p. 588; *Gren. et Godr. Fl. de France*, i. p. 241; *Reichb. Ic. Fl. Germ. Helv.* f. 5031.

44 centim. Folia linearia acuminata plana patentia stricta 5-nervia, radicalia 62 mm., caulina 53 mm., vagina folii diam. æquante. Flores solitarii aut 2–3 aggregati, speciosi inodori. Bracteæ 4 ovatæ ad dimidium calycem. Calyx apice attenuato, dentibus 7-nerviis. Petala contigua flabellata barbulata infra medium usque fimbriata; lamina rosea rarius alba, area intermedia orbiculari. Antheræ lineari-oblongæ. Capsula cylindrica. Semina ovalia.

b. alpestris, *Hoppe et Sternb.* (sp.), *in Sturm, Deutschl. Fl.* Heft 28; *Schultes, Oesterr. Fl.* ed. II. i. p. 662; *Reichb. Icon. Fl. Germ. Helv.* f. 5032 *b.*

12 centim. Rami uniflori.

c. erubescens, *Trev.* (sp.) *Jahrb. d. Gewaechsk.* ii. p. 32; *Kerner, Sched. Austro-Hung.* p. 74; *Reichb. Icon. Fl. Germ. Helv.* vi. fig. n. 5031.

Lamina pallide rosea.

d. exuberans, *Gib. et Pir. Fl. Moden.* p. 28 (1882).
Habitu robustissimus.

e. acuminatus, *Tausch* (sp.), *in Syll. Ratisb.* ii. p. 242; *Walp. Repert.* iv. p. 264.

f. compacta, *Krasan, in Oesterr. Bot. Zeitschr.* 1889, p. 402; *auct. Pinks Cent. Eur.* p. 30.

Geogr. limits.—*N.* Hungary, 47°. *E.* Caucasus, 48°.
S. Calabria, 40°. *W.* Corunna, in Spain, 8° W.

Linnæus elsewhere calls this species "*monspeliacus*," which, as Koch says, is doubtless a slip of the pen; though Gouan takes up this name afterwards.

68. D. MARSICUS, *Tenore, Syll. Fl. Neap.* p. 208; *Fl. Nap.* t. 228.
31 centim. Folia linearia acuminata canaliculata adpressa stricta 3-nervia, radicalia 58 mm., caulina 48 mm., vagina folii diam. æquante. Bracteæ 4 ovatæ ad dimidium calycem. Calyx dentibus purpureis 7-nerviis. Petala non contigua barbulata, lamina obovato-cuneata rosea rarius alba. Antheræ lineari-oblongæ cæruleæ.
Geogr. limits.—*E.* Central Italy. *W.* South of France.

69. D. SQUARROSUS, *Bieb. Fl. Taur.-Cauc.* i. p. 331; *Ledeb. Fl. Rossica,* i. p. 284; *Bieb. Cent. Pl. Rar. Rossic.* t. 33.
Cæspitosus, 56 centim. Caules tenues squarrosi pauciflori. Folia 18 mm., linearia acuta recurva canaliculata, vagina folii diam. duplo longiore. Bracteæ 4, ovatæ ad $\frac{1}{3}$ calycis, coriaceæ. Calyx apice attenuato, dentibus 7-nerviis. Petala barbulata non contigua, lamina pinnati-multipartita oblonga rosea.
Hab. S. Russia and S.W. Siberia.

** Caules tetragoni. Folia 3–5-nervia. Bracteæ mucronatæ adpressa. Calycis dentes lanceolati.

70. D. CONTROVERSUS, *Gaud. Fl. Helvetica,* iii. p. 157; *auct. Pinks Cent. Eur.* p. 30; *Reichb. Icon. Fl. Germ. Helv.* 5031.
Parum cæspitosus, 22 centim. Caules remote foliati. Folia 24 mm., linearia acuta canaliculata 3-nervia stricta patentia, vagina folii diam. æquante. Bracteæ 4 obovatæ ad $\frac{1}{3}$ calycis. Calyx purpureus apice attenuato, dentibus 7-nerviis. Petala non contigua; lamina rosea obovato-cuneata, = unguem.
Hab. Switzerland.

71. D. Sternbergii, *Sieber, Sched. ad Fl. Austr. Exsicc.* (1811); *Scop. Fl. Carniolica,* ed. II. i. 301 (1772), n. 508 (Tunica arenaria); *Reichb. Icon. Fl. Germ. Helv.* f. 5032 *b*.

Cæspitosus, glaucus. Caules biflorales, 26 centim. Folia elongato-linearia acuminata patentia plana, radicalia 55 mm. 5-nervia, caulina 38 mm. 3-nervia, vagina folii diam. æquante. Bracteæ 4 obovatæ ad $\frac{1}{3}$ calycis, purpureæ. Calyx erubescens, dentibus 9-nerviis. Petala barbulata non contigua; lamina rosea obovato-cuneata maculata.

Geogr. limits.—*N.* Mt. Jura, in Switzerland, 47°.
E. The Noric Alps, in Carinthia, 15°.
S. and *W.* Sierra d'Estrella, in Portugal.

72. D. aciculabis, *Fisch.* ex *Ledeb. Fl. Rossica,* i. p. 284; *Nym. Consp. Fl. Eur.* p. 105.

Cæspitosus. Caules 26 centim. Folia elongato-linearia acuta mollia 3-nervia, radicalia 18 mm., reliqua 16 mm., vagina folii diam. æquante. Bracteæ 4, exteriores ovatæ ellipticæve, interiores duplo longiores obovatæ ad $\frac{1}{4}$ calycis tubum, coriaceæ. Calyx apice attenuato, dentibus 7-nerviis. Lamina digitato-multifida rosea aut alba obovato-cuneata, = $\frac{1}{2}$ unguis, area intermedia obovata barbulata.

b. spiculifolius, *Schur* (sp.), ex *Nym. Consp. Fl. Eur.* p. 105, *et Suppl.* ii. p. 60.

Non cæspitosus. Calyx apice non attenuato.

Hab. Eastern Russia and Roumania.

*** Caules teretes. Flores subfasciculati. Bracteæ mucronatæ albo-marginatæ. Calycis dentes albo-marginati.

73. D. floribundus, *Boiss. in Tchihatch. Asie Min. Bot.* i. p. 221; *Fl. Orient.* i. p. 490.

Glaucus, multicaulis, 42 centim. Caules paniculato-corymbosi. Folia elongato-linearia acuminata stricta plana, 50 mm., 3–5-nervia, vagina folii diam. duplo longiore. Bracteæ 6, oblongæ adpressæ ad dimidium calycem pallidæ. Calyx dentibus lanceolatis acutis. Lamina pallide rosea oblonga imberbis laciniis paucis.

Hab. Mt. Ararat, and Turkish Armenia.

74. D. robustus, *Boiss. et Kotschy, in Boiss. Fl. Orient.* i. p. 492.

Basi suffrutescens. Caules 60 centim., dichotome ramosi, crassi.

Folia 70 mm. radicalia lineari-lanceolata acuta, caulina linearia acuminata, vagina folii diam. duplo longiore. Bracteæ 4, oblongæ adpressæ ad calycis apices pallidæ. Calyx dentibus lanceolatis. Petala barbulata non contigua; lamina obovato-cuneata rosea, $=\frac{1}{4}$ unguis.

Hab. Prov. of Musch, in Armenia.

75. D. STRAMINEUS, *Boiss. et Heldr. Diagn. Pl. Nov. Or.* ser. I. viii. p. 70; *Boiss. Fl. Orient.* i. p. 494.

Glaucus, basi suffrutescens, 30 centim. Caules superne parce et stricte ramosi. Folia 32 mm., lineari-subulata subtriquetra stricta adpressa canaliculata, radicalia elongata 5-nervia, caulina 3-nervia, vagina folii diam. 3-plo longiore. Flores racemose approximati, sæpe bini aggregati, albi. Bracteæ 6, oblongæ stramineæ adpressæ ad dimidium calycem. Calyx dentibus ovatis. Petala imberbia non contigua; lamina ad palmatim $\frac{3}{4}$ multifida, area intermedia ovata.

Hab. Cilicia, in Asia Minor.

**** Caules teretes. Folia 5–7-nervia acuminata. Bracteæ 4–6. Calycis dentes 9-nervii.

76. D. LILIODORUS, *Panč.*; *auct. Pinks Cent. Eur.* p. 30.

Caules 33 centim. Folia elongato-linearia, radicalia 33 mm., reliqua 24 mm., adpressa carinata; vagina caulis diam. æquante. Flores albi odoratissimi. Bracteæ 4 obovato-oblongæ mucronatæ ad $\frac{1}{4}$ calycis partem. Calyx apice attenuato, dentibus lanceolatis. Lamina obovato-spathulata imberbis, $=\frac{1}{3}$ unguis.

Hab. N. Servia.

77. D. WALDSTEINII, *Sternb. in Flora*, 1826, i. *Beil.*, p. 73; *Reichb. Fl. Germ. Exc.* p. 808; *Timb. Dianth. Pyr. Fr.* p. 18, t. 23.

Caules 50 centim. Folia linearia flaccida plana patentia, radicalia 53 mm., reliqua 48 mm., vagina caulis diam. æquante. Flores rosei odoratissimi. Bracteæ 4 ovatæ acuminatæ ad dimidium calycem vel ultrà, patentes. Calyx apice attenuato, dentibus lanceolatis. Petala non contigua; lamina imberbi obovata ad medium lacinulata, $\frac{1}{3}$ unguis. Antheræ cæruleæ.

Geogr. limits.—*N.* Noric Alps, in Styria, 47°.
S. Principality of Montenegro, 43°.
E. West Servia, 20°.
W. Department of Hautes Pyrénées, France, 0°.

78. D. Zeyheri, *Harv. et Sond. Fl. Capensis*, i. p. 124; *Walp. Ann.* vii. p. 267.

Glaucus, 50 centim. Caules stricti ramis angularibus. Folia 7-nervia canaliculata, inferiora oblongo-lanceolata, intermedia lanceolata 44 mm., superiora subulata abbreviata; vagina folii diam. æquante. Bracteæ ovatæ acuminatæ adpressæ ad $\frac{1}{4}$ calycis partem. Calyx purpureus, dentibus lanceolato-linearibus. Petala non contigua; lamina late obovata alba barbulata.

Hab. Macallisberg, in Cape Colony.

***** Caules teretes. Folia 9–11-nervia acuminata. Bracteæ 2–6, adpressæ.

79. D. purpureus, *mihi, in Journ. of Botany*, 1885, p. 343; *Enum. spp. varr. Dianthus*, p. 13.

Caules tenues ramis angularibus. Folia elongato-linearia adpressa, vagina caulis diam. æquante purpurea. Bracteæ 4, ovatæ acuminatæ ad dimidium calycem, stramineæ. Calyx purpureus, dentibus lanceolatis 7–9-nerviis. Lamina purpurea.

Hab. Mt. Hermon, in Palestine (*Herb. Kew.*).

Specimens of this plant were received at Kew in 1879. Of the species in the 'Fl. Orientalis,' it seems nearest to *D. tabrisianus*. The same specific name has been previously used by Poiret for a plant which cannot now be identified.

80. D. mecistocalyx, *mihi, in Journ. of Botany*, 1889, p. 199.

Glaucus, 45–48 centim. Caules a medio divaricatim et dichotome ramosi. Folia elongato-linearia; radicalia 66–68 mm., patentia 7-nervia, vagina folii diam. duplo longiore, cetera 25 mm. adpressa, vagina folii diam. æquante. Flores solitarii albi. Bracteæ 4–6 obovatæ, 2 infimis obovato-lanceolatis, mucronatæ ad $\frac{1}{3}$ calycis. Calyx 36 mm., dentibus lanceolato-linearibus 9-nerviis margine scabris. Capsula ovoidea.

Hab. Apies River, in the Pretoria district of the Transvaal (*Herb. Kew.*).

81. D. moviensis, *mihi, in Journ. of Botany*, 1889, p. 199.

Glaucus, 25 centim. Caules superne stricte et dichotome ramosi. Folia 15 mm. linearia adpressa, vagina folii diam. duplo longiore. Flores solitarii laxe cymosi albi. Bracteæ 6 obovatæ, 2 infimis obovato-lanceolatis, mucronatæ ad $\frac{1}{3}$ calycis. Calyx

dentibus lanceolatis 9-nerviis. Petala non contigua, lamina obovata. Capsula ovoidea. Semina minute tuberculata.

Hab. Movi River, Transvaal (*Herb. Kew.*).

82. D. KUSCHAKEWICZI, *Regel et Schmalh. in Act. Hort. Petropolit.* v. (1877), p. 244; *auct. Enum. spp. varr. Dianthus*, p. 13.

Folia linearia flaccida patentia, vagina folii diam. æquante. Bracteæ 4, inferiores oblongo-ellipticæ, superiores ovato-ellipticæ, acuminatæ ad dimidium calycem. Calycis dentes lineares. Petala non contigua, lamina oblonga imberbi.

Hab. Turkestan.

****** Non glauci. Caules tetragoni. Folia 1–7-nervia. Bracteæ 4–8. Calycis dentes lanceolati. Petala non contigua.

83. D. SERRULATUS, *Desf. Fl. Atlantica*, i. (1798), p. 346; *auct. Pinks West Eur.* p. 17; *Willk. Icon. Descr. Pl. Crit. Hisp.* i. t. 7.

40 centim. Caules tenues. Folia elongato-linearia plana; radicalia 64 mm., 7-nervia acuta, caulina 30 mm., 5-nervia acuminata; vagina folii diam. æquante. Bracteæ 8, lanceolatæ acuminatæ ad $\frac{1}{3}$ calycis, patentes coriaceæ. Calyx apice attenuato, dentibus 7-nerviis. Lamina barbulata purpurea obovato-cuneata.

Geogr. limits.—*N.* Andalusia, 38°. *E.* Tunis, 10°.
S. Algeria, 30°. *W.* Morocco, 10°.

So named by Desfontaines, from the incised margin of the petals. The plant is not to be confounded with Schlosser's homonym, which is a Croatian species, and differs from this North-African plant in the following points:—cæspitose in habit; stems much shorter, simple, and angularly compressed, with the angles more acute than in this species; leaves plane, with the sheath twice as long as broad; bracts 4, more broadly ovate and reaching to the apices of the calyx, thinner and more membranous in texture; and teeth of the calyx reddish. (See p. 408.)

84. D. TABRISIANUS, *Bien. in Bunge, Pl. Persic. Exsicc.* ex *Boiss. Fl. Orient.* i. p. 496, *et Supplem.* p. 78; *Regel et Schmalh. in Act. Hort. Petropolit.* v. (1877), p. 244.

Basi suffrutescens, 24 centim. Folia 25 mm., stricta linearia acuta adpressa canaliculata uninervia, vagina folii diam. duplo longiore. Bracteæ 4 ovali-oblongiore mucronatæ adpressæ ad $\frac{1}{4}$ calycis partem. Calyx dentibus 7-nerviis. Lamina alba imberbis ovato-oblonga in lacinias latitudini areæ æquilongas vel subbreviores partita. Antheræ pallidæ.

Geogr. limits.—*N.* Turkestan, 40°.
S. Near Shiraz, in Persia, 30°.
W. Near Tabreez, in Persia, 46°.
E. Affghanistan, 68°.

According to Regel and Schmalhausen, in the specimens found in Turkestan the petals are more jagged.

85. D. PLUMOSUS, *Spreng. Pugill.* 2, p. 64; *auct. Pinks Cent. Eur.* p. 31.

55 centim. Folia 25 mm., 3–5-nervia linearia plana flaccida, vagina folii diam. duplo longiore. Bracteæ 4, exteriores ovatæ, interiores obovatæ, patentes acuminatæ ad calycis apices. Calyx apice attenuato, dentibus 9–11-nerviis purpureis. Lamina imberbis obovato-cuneata.

Geogr. limits.—*N.* Mt. Baldo in Venetia, near the Austrian frontier.
S. Shores of Lake Garda, between Venetia and Lombardy.

86. D. VALENTINUS, *Willk. Icon. Descr. Pl. Nov. Hisp.* i. p. 14, t. 7; *Amo, Fl. Iber.* vi. p. 293.

Cæspitosus. Caules 50 centim., dichotome ramosi fastigiati stricti. Folia plana adpressa acuta 3-nervia; radicalia 52 mm. linearia, caulina inferiora lineari-lanceolata, intermedia elongato-linearia; vagina folii diam. æquante. Bracteæ sæpissime 6, obovato-lanceolatæ mucronatæ ad dimidium calycem, arcte imbricatæ. Calyx apice attenuato, dentibus ciliolatis. Lamina speciosa barbulata oblonga rosea ad $\frac{1}{3}$ fimbriato-lanceolata, = unguem. Antheræ lanceolato-ellipticæ flavæ. Capsula ovoidea. Semina subtilissime striolata.

Geogr. limits.—*N.* R. Ebro. *E.* Tortosa, in Catalonia.
S. Malaga. *W.* N. Portugal.

******* Caules teretes. Folia 1–3-nervia. Bracteæ scarioso-alatæ. Calyx apice non attenuato, dentibus lanceolatis.

87. D. PROSTRATUS, *Jacq. Pl. Rar. Schönbr. Icon.* iii. t. 271; *Harv. et Sond. Fl. Capensis*, i. p. 325.

100 centim. Folia 33 mm., patentia recurva acuta 3-nervia, radicalia lineari-lanceolata, cetera linearia, vagina folii diam. duplo longiore. Bracteæ 4, patentes ovato-lanceolatæ acuminatæ ad

$\frac{1}{3}$ calycis. Calyx dentibus ciliolatis. Petala non contigua, lamina barbulata obovata rosea vel alba.

Hab. Cape Colony.

88. D. Hoeltzeri, *Winkl. in Regel, Gartenflora*, 1881, p. 1, t. 1032; *auct. Enum. spp. varr. Dianthus*, p. 13.

Cæspitosus. Folia stricta acuminata, radicalia subspathulata, caulina lineari-lanceolata, vagina folii diam. æquante. Bracteæ 2 obovato-lanceolatæ mucronulatæ adpressæ ad dimidium calycem. Petala non contigua; lamina barbulata maculata rosea vel flavescente, =unguem.

b. ebarbata, *Winkl. loc. cit.* p. 1.

Lamina vix barbulata, pallidissima.

Hab. Turkestan.

89. D. sinaicus, *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 23; *Fl. Orient.* i. p. 497.

Glaucus, basi suffrutescens, 34 centim. Caules a basi divaricatim et dichotome ramosi. Folia minuta subulata stricta canaliculata, radicalia 18 mm. patentia, caulina 5 mm. adpressa, vagina folii diam. æquante. Bracteæ 10 obovatæ mucronatæ stramineæ arcte adpressæ ad $\frac{1}{3}$ calycis. Petala non contigua, lamina imberbi oblonga ad $\frac{3}{4}$ laciniata.

Hab. Peninsula of Sinai, in Arabia.

Locally called "Sammah."

90. D. polylepis, *Bien. Pl. Persic. Exsicc.*, ex *Boiss. Fl. Orient.* i. p. 497.

Glaucus, basi suffrutescens, 28 centim. Caules tenues virgati. Folia minuta subulata rigida carinata, radicalia acuta patentia, caulina acuminata adpressa, vagina folii diam. æquante. Bracteæ 10 lanceolatæ acuminatæ pungentes arcte adpressæ ad dimidium calycem. Petala non contigua, lamina imberbi obovata ad $\frac{3}{4}$ laciniata.

Geogr. limits.—W. Near Mesched in prov. Khorassan, Persia, 60°.

E. Between Herat and Tebes, in Affghanistan, 62°.

Differs from the preceding in its acuminate bracts, shorter calyx, in the small lamina almost concealed by the calyx, and in its stricter habit.

Subsectio 3. *Cycaxostolon.*

Caules simplices teretes. Calycis dentes acuminati.

* Bracteæ mucronatæ. Lamina imberbis.

91. D. GRAMINIFOLIUS, *Presl, Fl. Siculà,* i. p. 147; *Guss. Fl. Sic. Syn.* i. p. 480.

Glaucus, glaber, 52 centim. Folia 70 mm., 3-nervia graminea linearia acuta plana, vagina folii diam. æquante. Bracteæ 4 obovatæ adpressæ ad $\frac{1}{4}$ calycis, stramineæ. Calyx apice attenuato, dentibus lanceolatis. Petala contigua, lamina obovato-cuneata rosea. Capsula ovoidea.

Hab. Sicily.

First described by Presl as a variety of *D. Arrostii.*

92. D. ERYTHROCOLEUS, *Boiss. Fl. Orient.* i. p. 493.

Cæspitosus, glaber, 5 centim. Caules uniflori. Folia 12 mm., elongato-linearia acuta 3-nervia plana stricta adpressa; vagina folii diam. æquante. Bracteæ 4 rubræ oblongæ adpressæ ad $\frac{1}{3}$ calycis. Calyx dentibus lanceolatis. Petala contigua, lamina oblongo-cuneata rosea fere ad medium fimbriata.

Hab. Kurdish Armenia.

93. D. NOËANUS, *Boiss. Diagn. Pl. Nov. Or.* ser. II. i. p. 67; *Fl. Orient.* i. p. 494.

Cæspitosus, glaber. Folia lineari-lanceolata acuminata patentia stricta pungentia plana, radicalia 25 mm. 5-nervia, reliqua 22 mm. 3-nervia, vagina folii diam. æquante. Flores subfasciculati odorati albi. Bracteæ 6 oblongæ adpressæ ad $\frac{1}{4}$ calycis, infimis brevioribus. Calyx stramineus apice attenuato, dentibus lanceolatis. Petala non contigua; lamina lineari-subcuneata ultra medium in lacinias partita, $=\frac{1}{4}$ unguis.

Geogr. limits.—W. Servia. *E.* Banks of the Euphrates.

94. D. PETRÆUS, *Waldst. et Kit. Pl. Rar. Hungariæ,* t. 222; *Boiss. Fl. Orient.* i. p. 493; *Sims, Bot. Mag.* t. 1204.

Cæspitosus, glaber. Caules graciles primo decumbentes dein erecti, 23 centim., uniflori. Folia 25 mm., lineari-lanceolata acuta patentia incurva carinata pungentia 3-nervia, vagina folii diam. duplo longiore. Flores odorati albi. Bracteæ 4 rubellæ stramineæ obovatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx apice attenuato, dentibus lanceolatis. Petala non contigua; lamina obovata, $=\frac{1}{2}$ unguis, area intermedia ovata. Antheræ oblongæ flavicantes.

b. bohemicus, *F. W. Mey. in Flora,* 1830; *auct. Pinks Cent. Eur.* p. 32.

Folia linearia. Flores bini.

c. brevifolia, *Rupr. in Act. Hort. Petropolit.* ii. (1881), p. 506.

d. strictifolia, *Rupr. in Act. Hort. Petropolit.* ii. (1881), p. 506. Folia rigidiora.

Geogr. limits.—*N.* Galicia, in Austria.
S. Mt. Rhodope, in Bulgaria.
E. Bucieciu, in Moldavia.
W. Croatia, in Austria.

In the original plate cited above, by an error of the draughtsman, the petals are represented as dentate instead of fimbriate. On the authority of this plate, without examining specimens or consulting the original description, Simonkai joined with this species the *D. integripetalus* of Schur, a plant from Butsets in Lerchenfeld's Transylvanian herbarium (1780). The original specimens from which Kitaibel described the species were from the territorial district of Bihar, in Hungary. The authority for the northern limit is Herbich (Addit. ad Fl. Galiciæ): that for the southern limit is Friwaldsky, who found it on Mt. Rhodope in 1836: for the eastern limit, Fronius, who recorded it in Roumania: and for the western limit, Schlosser ('Flora Croatica').

95. D. SERPÆ, *Hiern, in Trans. Linn. Soc.* ser. II. *Bot.* ii. (1881), p. 17.

Caules glabri uniflori, 72 centim. Folia 72 mm., lineari-lanceolata acuta carinata coriacea stricta adpressa, vagina folii diam. æquante. Bracteæ 4 obovatæ stramineæ adpressæ ad $\frac{1}{3}$ calycis. Calyx dentibus ovato-lanceolatis. Petala non contigua; lamina spathulato-obovata alba, $=\frac{1}{2}$ unguis.

Collected by the Portuguese traveller, Major Serpa Pinto, in August 1878, along the upper course of the River Ninda, an affluent of the Zambesi, on the west side of the high plateau, at an elevation of 1140 metres above the sea. Whether it is cæspitose or not cannot be determined, as the specimen consists only of a flowering stem.

96. D. GALLICUS, *Pers. Syn.* i. p. 495; *Gren. et Godr. Fl. de France*, i. p. 242; *DC. Icon. Pl. Gall. Rar.* p. 12, t. 41 (D. arenarius).

Pubescens, glaucus, gracilis, 25 centim. Folia 18 mm., 3-nervia linearia obtusa plana incurva, vagina folii diam. æquante.

Flores rosei aut albi, odorati. Bracteæ 4 obovatæ adpressæ ad $\frac{1}{4}$ calycis partem, scarioso-alatæ. Calyx apice attenuato, dentibus lanceolatis 9-nerviis. Petala contigua; lamina subrotunda ad $\frac{1}{3}$ longit. laciniata, $=\frac{1}{3}$ unguis, area intermedia obovata. Antheræ oblongæ.

b. lusitanus, *Sjögr.*, ex *Nym. Consp. Fl. Eur.* p. 104; *auct. Pinks West Eur.* p. 20.

Folia rigida stricta; vagina rubella.

Geogr. limits.—*N.* Dept. of Finisterre, 48°.
S. R. Douro, 41°.
E. Dept. of Gironde, 0°.
W. Oporto, 9°.

First recorded on the west coast of France. Like *D. liburnicus*, it is one of the few maritime species. First found in Portugal by P. B. Webb, in 1838, in pine-woods on the west coast. This botanist did not give it a distinct varietal name, but it is the var. *b* mentioned above.

97. D. MACRANTHUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I, i. p. 23; *Fl. Orient.* i. p. 497.

Basi suffrutescens, glaber. Caules 30 centim., uniflori. Folia 18 mm., 3-nervia anguste linearia acuminata stricta adpressa, vagina folii diam. æquante. Bracteæ 14–16 obovatæ adpressæ ad $\frac{1}{4}$ calycis. Calyx 44 mm., dentibus lanceolatis 9-nerviis. Petala non contigua pallide rosea vel alba; lamina oblongo-cuneata ultra medium palmatim multifida, $=\frac{1}{3}$ unguis.

Hab. S. Persia.

Differs from *D. sinaicus* in having simple stems, more numerous bracts, and a thick and very long calyx.

98. D. BASIANICUS, *Boiss. et Haussk. in Fl. Orient. Supplem.* p. 77.

Basi suffrutescens, pruinoso-tomentellus, 25 centim. Folia subulata acuta stricta, inferiora 14 mm., vagina folii diam. æquante. Bracteæ 4 oblongæ adpressæ ad $\frac{1}{4}$ calycis. Calyx dentibus lanceolatis. Petala non contigua, lamina oblongo-spathulata alba ad medium multifida, area intermedia ovata.

Hab. Mesopotamia.

** Bracteæ acuminatæ. Lamina imberbis.

99. D. SESSILIFLORUS, *Boiss. Fl. Orient. Supplem.* p. 78.

Cæspitosus, nanus, subacaulis. Folia 10 mm., omnia radicalia congesta linearia acuta flexuosa carinata 3-nervia. Flores in

cæspite subsessiles solitarii. Bracteæ 4 lanceolatæ scarioso-alatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx dentibus lanceolatis scarioso-alatis. Lamina alba parva oblongo-spathulata ultra medium multifida.

Hab. Kurdish Armenia.

100. D. ATOMARIUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. viii. p. 71; *Fl. Orient.* i. p. 492.

Glaber, 25 centim. Rhizoma sublignosum. Folia linearia acuminata stricta canaliculata adpressa, vagina folii diam. æquante; radicalia latiora 72 mm. 7-nervia, caulina 50 mm. 5-nervia. Bracteæ 4 oblongæ margine rubellæ patentes ad calycis apices. Calyx dentibus triangularibus margine ciliolatis 7-nerviis. Petala non contigua; lamina pallida nigro-punctata obovato-cuneata in lacinias setaceas ad medium usque multifida, $=\frac{1}{4}$ unguis, areola intermedia ovata.

b. setisquameus, *Haussk. et Bornm.* (sp.) *in Pl. Exsicc. Anatoliæ Orientalis*, no. 975 (inedit.).

35 centim. Caules tenues. Folii vagina caulis diam. duplo longior. Bracteæ 6 sensim longissime acuminatæ fere ad basin calycis dentium, 2 exteriores lineares, interiores lanceolato-lineares, arista herbacea. Calyx dentibus lanceolato-linearibus. Lamina lilacina, $=\frac{1}{2}$ unguis.

This plant, which may be considered a variety of *D. atomarius*, rather than a distinct species, is described from specimens recently sent to Kew, and dated 1 Aug. 1889.

Hab. Kurdish Armenia and North Persia.

*** Calycis dentes lanceolati acuminati 7 nervii.
Lamina barbulata.

101. D. FALLENS, *Timb. in Bull. Soc. Bot. France*, v. (1858), p. 329; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 686; *Timb. Dianth. Pyr. Fr.* p. 19, t. 25.

Glaber. Caules 1–2-flori, 20 centim. Folia rigida falcata patentia; radicalia obtusa 5-nervia, caulina acuminata 3-nervia 25 mm., vagina folii diam. æquante. Bracteæ 4 scarioso-alatæ mucronatæ ad dimidium calycem, exteriores lanceolatæ, interiores obovato-lanceolatæ. Calyx apice attenuato. Petala contigua; lamina rhomboidea ad $\frac{1}{3}$ regulariter laciniata, $=\frac{1}{4}$ unguis, area intermedia obovato-cuneata.

Geogr. limits.—*N.* Central Pyrenees. *E.* Rep. of Andorra.
S. R. Ebro. *W.* R. Aragon.

102. D. FIMBRIATUS, *Bieb. Fl. Taur.-Cauc.* i. p. 332; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 685 (D. Broteri); *Boiss. Voy. Bot. Espagne*, p. 84, t. 3 (D. serrulatus var. grandiflorus); *mihi* (sensu latiore), *Pinks West Eur.* p. 18.

Suffrutescens, glaber. Folia linearia acuta adpressa 3-nervia, plana vel canaliculata. Bracteæ variabiles 4–8 (rarius 10–12), ovali- v. oblongo-lanceolatæ, $\frac{1}{3}$ calycis longit. coriaceæ v. stramineæ. Calyx sæpius rubellus, apice attenuato. Petala non contigua, formâ variabilia. Capsula oblonga.

+ Cæspitosi glauci. Bracteæ 8.

b. mutica, *mihi* (=D. scoparius, *Fenzl*), *Boiss. Fl. Orient.* i. p. 494; *et Supplem.* p. 77.

Dumosa multicaulis. Caules stricti uniflori. Bracteæ obtusissimæ vel subretusæ mucronulatæ, coriaceæ. Lamina ovato-oblonga ad $\frac{1}{2}$–$\frac{1}{3}$ laciniata, area intermedia elliptica.

c. mucronulata, *mihi*, *Enum. spp. varr. Dianthus*, p. 14; *Pinks West Eur.* p. 19.

Folia rigida. Bracteæ suborbiculares mucronulatæ. Calyx apice non attenuato.—Herb. Kew. ex Hispania, et Herb. Mus. Brit. ex Herb. Graëlls. (=?? *D. Broteri*, et *D. fimbriatus* Brot.).

d. Hookeri, *mihi* (= var. innom. in *Hook. f. Fl. Brit. Ind.* i. p. 215), *Enum. spp. varr. Dianthus*, p. 14.

Folia caulina 72 mm., atroviridia. Bracteæ foliaceæ ovatæ acuminatæ.—Mtes. Himalay.

e. sclerophyllus, *Willk. Pugill. Pl. Nov. Pyr.* p. 90; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 684.

Folia radicalia recta divaricato-patentia. Flores geminati intense rosei.

f. brachyphyllus, *Willk. Pugill. Pl. Nov. Pyr.* p. 90; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 684.

Folia radicalia erecto-patula. Bracteæ late lanceolatæ. Flores geminati. Calyx superne valde attenuatus. Lamina intense rosea.

g. leptophyllus, *Willk. Pugill. Pl. Nov. Pyr.* p. 90; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 684.

Folia radicalia anguste linearia longa, omnia plana curvata. Bracteæ late lanceolatæ. Flores geminati. Calyx superne valde attenuatus. Lamina rosea, obovato-cuneata.

The three preceding varieties comprise *D. attenuatus*, subsp. *catalaunicus*, of the *Prodr. Fl. Hisp. l. c.*

‡ Viridis, non cæspitosus. Bracteæ 12.

h. orientalis, *Donn* (sp.), *Hort. Cantabr.* ed. IV. p. 101 ; *Sims*, *Bot. Mag.* t. 1069.

Folia pungentia canaliculata. Bracteæ obovatæ arcte imbricatæ stramineæ. Flores odorati. Lamina lineari-cuneata rosea, $= \frac{1}{2}$ unguis.

The plate of this plant was published by Sims in 1807, and is in the text identified with Tournefort's " Caryophyllus orientalis fruticosus, tenuissimo folio, flore laciniato." He further says :— " This plant has great affinity with *D. juniperinus*, of Dr. Smith, specimens of which, gathered by Tournefort, are to be seen in the Banksian Herbarium; but differs from it in several respects: the woody part of the stem is of humbler growth, the flowering stalks longer, with short more closely adpressed leaves, and bearing fewer flowers, generally only one in its native soil, and from one to three when cultivated ; scales of the calyx more in number and more closely imbricated; tube much longer, slenderer, and more pointed; petals longer, more deeply jagged, and twisted. Found about Tiflis, in Russian Georgia."

+‡ Virides, non cæspitosi. Bracteæ 4.

i. incertus, *Jacquem. in Hook. f. Fl. Brit. Ind.* i. p. 215; *auct. Enum. spp. varr. Dianthus*, p. 14.

Bracteæ ovatæ acuminatæ. Lamina obovato-oblonga.

j. obtusisquameus, *Boiss. Fl. Orient.* i. p. 495; *auct. Enum. spp. varr. Dianthus*, p. 14.

Folia flaccidula canaliculata, vagina folii diam. duplo longiore. Bracteæ mucronulatæ. Calyx purpureus. Lamina rosea.

‡‡ Non cæspitosi. Bracteæ 6–8. Lamina rosea.

k. macropetalus, *Boiss. Fl. Orient. Supplem.* p. 77.

Folia non stricta, sed erecto-patentia, vagina folii diam. æquante. Lamina magna obovato-oblonga.

Hab. Turkestan.

l. pogonopetalus, *Boiss. et Kotschy* (sp.), *Diagn. Pl. Nov. Or.* ser. II. vi. p. 29; *Boiss. Fl. Orient. Supplem.* p. 77.

Caules uniflori. Folia rigida. Bracteæ 4 margine anguste scariosæ. Calyx viridis, dentibus ciliolatis. Lamina oblongo-spathulata valde barbulata, rosea.

Hab. Mt. Lebanon.

m. brachyodontus, *Boiss. et Huet, Diagn. Pl. Nov. Or.* ser. II. v. p. 53; *Boiss. Fl. Orient.* i. p. 495.

Folia stricta, vagina folii diam. duplo longiore. Bracteæ mucronatæ obovatæ. Calyx dentibus purpureis. Lamina rosea.

Hab. Armenia and N. Persia.

n. angulatus, *Royle, Illustr. Bot. Himal.* t. 79; *Hook. f. Fl. Brit. Ind.* i. p. 215.

Glaucus. Caules infra 4-angulares. Folia flaccida, vagina folii diam. æquante. Lamina obovato-oblonga rosea.

o. stenocalyx, *Boiss. Fl. Orient.* i. p. 495.

Glaucus. Folia stricta vagina folii diam. æquante. Bracteæ
8 oblongæ acuminatæ. Lamina parva pallidissima obovato-oblonga, $=\frac{1}{2}$ unguis.

Hab. Mt. Elburz, in N. Persia.

The specific type, in the broader sense, is very widely distributed—in Spain, Portugal, Morocco, Algeria, the Caucasus, and Turkestan, and in the East from the Levant to West Tibet and Scinde: growing on dry hills, rocky places, and sandy slopes. I can see no reason whatever for separating this plant of the Caucasian Iberia from Brotero's plant of the other (Western) Iberia, as Boissier has done, distinguishing the latter by the name of *D. Broteri.* Both plants are extremely variable and typically polymorphous. All the forms are suffruticose below, where the rootstock is vertical or oblique, dividing into many branches producing flowering stems and leafy shoots. The growth of the leafy shoots is generally vigorous, giving the plant a cæspitose habit: this is more marked in the Spanish and North-African forms, probably from the habitat. The stems are terete, simple, and frequently unifloral, though they may be forked near the base, strict, slender, and erect or ascending from the crown of the rootstock, and usually fastigiate and equal in height. The leaves are generally glaucous, though in very high stations this glaucescence is absent; they are linear, adpressed, and 3-nerved (with the nerves very prominent on the under surface), and vary considerably in length; the edges are rough and bordered with the lateral nerves, and the length of the leaf-sheath is equal to or twice its breadth. The bracts vary considerably in form, number, and texture, even in the same localities. In the typical forms there are four pairs (or five, with the lowest pair foliaceous) closely applied along one-third

the length of the tube of the calyx, oval, or oblong-lanceolate and mucronulate, with the nerves distinctly prominent. The calyx is generally contracted above, with the teeth 7–9-nerved and ciliolate at the margin, and is sometimes as long as 30 mm. The lamina of the petal is bearded, though in some of the Western forms this capillary outgrowth is slight, and almost evanescent. The capsule is oblong, substipitate, and slightly exserted.

Geogr. limits.—*N.* Caucasus, 42°.
S. Scinde, in Hindostan, 25°.
E. West Tibet, 76°.
W. Portugal, 8°.

Subsectio 4. *Gonaxostolon.*

Caules simplices, tetragoni. Calycis dentes acuminati.

* Cæspitosi. Bracteæ sensim acuminatæ.

103. D. MICROPETALUS, *E. Mey.* ex *Harv. et Sond. Fl. Capensis*, i. p. 122.

25 centim. Caules tenues uniflori. Folia linearia acuminata stricta adpressa; radicalia 12 mm. carinata, caulina 5 mm. plana, vagina purpurascente folii diam. æquante. Bracteæ 4 scarioso-alatæ ovato-lanceolatæ stramineæ adpressæ ad dimidium calycem. Calyx dentibus lanceolatis 9-nerviis purpurascentibus. Petala contigua; lamina rosea minuta obovata imberbi, $=\frac{1}{4}$ unguis.

a. scaber, *mihi.*

b. glabratus, *Sond.*

c. graminifolia, *Fenzl, in Szyszyl. Enum. Polypet. Rehmann* (1887).

Hab. South Africa.

Thunberg's earlier name, *D. scaber*, is altogether inappropriate; as, besides being insufficiently distinctive, the glabrous form is more frequently met with. The same name has also been used for species (?) described by Chaix and Schleicher.

104. D. TENER, *Balb. in Mém. Acad. Turin*, vii. (1802), p. 14, t. 3; *Bertol. Fl. Italica*, iv. p. 561.

Glaber, 12 centim. Caules tenues uniflori. Folia 20 mm., anguste linearia obtusa uninervia stricta plana patentia, vagina

folii diam. æquante. Bracteæ 2 (rarius 4) lanceolatæ patentes ad dimidium calycem. Calyx dentibus lanceolatis. Petala contigua; lamina rosea oblongo-cuneata imberbi maculata, $=\frac{1}{2}$ unguis, area intermedia rhomboidea. Antheræ ellipticæ.

Hab. Dept. of Alpes Maritimes, France.

This is not an Italian species, as frequently stated. The original locality given by Balbis is, "sur les bords des champs dans les montagnes de Tende," which is in the area ceded with Nice to France in 1860. Neither is it the *D. tener* of the 'Flore de France,' which=*D. fallens*, Timb. Reichenbach refers the plant to *D. Waldsteinii*, and Bertoloni, who examined Balbis's original specimens, was of the same opinion. On the other hand, W. D. J. Koch referred it to *D. neglectus*, to which it is similar in many points, but the latter is certainly not a fimbriate species. The plant was raised from seeds from the original locality, in the Jardin des Plantes, and showed no variation in the course of ten years.

** Cæspitosi. Bracteæ abrupte mucronatæ.

105. D. PRÆVERTENS, *mihi*;=D. serrulatus, *Schloss. Syll. Fl. Croaticæ*, p. 192; *auct. Pinks Cent. Eur.* p. 33.

Glaber, 20 centim. Caules graciles tenues 1–2-flori, primo decumbentes, dein ascendentes. Folia elongato-linearia stricta canaliculata, radicalia 50 mm. 7-nervia acuminata, caulina 33 mm. 5-nervia acuta, vagina folii diam. duplo longiore. Bracteæ 4 ovatæ stramineæ patentes ad $\frac{1}{4}$ calycis. Calyx apice attenuato, dentibus lanceolatis fusco-rubellis. Lamina imberbis alba obovato-cuneata. Capsula cylindrica.

Hab. Croatia.

106. D. SEROTINUS, *Waldst. et Kit. Pl. Rar. Hungariæ*, ii. p. 188, t. 172; *Schultes, Oesterr. Fl.* ed. II. i. p. 650; *Reichb. Icon. Fl. Germ. Helv.* 5027.

Glaber, glaucus. Caules 22 centim., graciles tenues biflori. Folia 20 mm., linearia acuta patentia recurva canaliculata, vagina folii diam. æquante. Flores odorati. Bracteæ 6 (v. 4), obovatæ adpressæ ad $\frac{1}{4}$ calycis. Calyx gracilis tenuis, dentibus triangularibus ciliolatis purpurascentibus. Petala alba non contigua; lamina obovato-cuneata barbulata maculata profunde multifida, $=\frac{1}{2}$ unguis. Antheræ oblongæ luteo-albæ. Semina granulata.

b. hungaricus, *Pers.* (sp.) *Syn.* i. p. 495; *Neilr. Diagn. Pl. Hung. Slavon.* p. 23.

Calyx apice attenuato. Petala contigua.

Geogr. limits.—*N.* Poland.
S. Croatia.
E. Prov. of Volhynia, in Russia.
W. The Julian Alps, in Carniola.

107. D. CANESCENS, *Koch, in Linnæa,* xv. p. 710; *Ledeb. Fl. Rossica,* i. p. 774.

Basi suffrutescens, holosericeus, 27 centim. Folia 19 mm., linearia acuta stricta canaliculata aspero-hirta, vagina folii diam. duplo longiore. Flores rosei aut albi. Bracteæ 6 oblongæ scarioso-alatæ ad $\frac{1}{3}$ calycis adpressissimæ. Calyx dentibus lanceolatis rubris. Petala non contigua; lamina barbulata oblonga, area intermedia elliptica.

Hab. Russian Armenia.

108. D. CRINITUS, *Sm. in Trans. Linn. Soc.* ii. (1794), p. 300; *Boiss. Fl. Orient.* i. p. 496, *Supplem.* p. 78; *Sibth. Icon. Fl. Græc.* t. 401.

Basi suffrutescens. Caules stricti. Folia 24 mm., anguste linearia acuta carinata patentia recurva uninervia, vagina folii diam. æquante. Flores solitarii speciosi albi. Bracteæ 4 oblongæ ad $\frac{1}{4}$ calycis adpressissimæ. Calyx dentibus lanceolatis 7-9-nerviis. Petala contigua; lamina imberbi oblonga in lacinias capillaceas latit. areæ multo longiores multifida. Antheræ albæ.

a. typicus, *Sm. in Trans. Linn. Soc.* ii. (1794), p. 301.

Glaber. Caules 16–20 centim. Calycis dentes 9-nervii. Lamina profundissime sæpe usque ad basin multifida.

b. tomentellus, *Boiss. Fl. Orient.* i. p. 496, *Supplem.* p. 78.

27 centim. Caules et folia tomentella. Calycis dentes 7-nervii.

c. crossopetalus, *Fenzl* (sp.), ex *Boiss. Fl. Orient.* i. p 496, *Supplem.* p. 78.

Pumilus, glaber. Bracteæ ovali-lanceolatæ.

d. pubescens, *Boiss. Fl. Orient.* i. p. 497 (D. tabrisianus *var.*).

Pubescens. Calyx apice attenuato, dentibus albo-marginatis.

Geogr. limits.— *N.* Samarcand, in Turkestan.
S. Beluchistan, 26°.
E. The Punjâb, N.W. India.
W. Island of Rhodes, 28°.

Sir J. E. Smith identifies with his species one of Tournefort's plants, "Caryophyllus orientalis minimus tenuissime laciniatus flore purpureo." By an error, probably typographical, its habitat is given as "Armeria" instead of Armenia. The name is derived from the hair-like fimbriation of the petals.

109. D. Engleri, *Haussk. et Bornm. in Pl. Exsicc. Anatoliæ Orientalis*, no. 984 (inedit.).

Holosericeus, pumilus, 4–5 centim., subacaulis, basi suffrutescens, surculis 8 mm. Folia 3-nervia acicularia pungentia squarrosa, vagina folii diam. æquante. Bracteæ 4 ovatæ patentes cuspidatæ ad bases calycis dentium. Calyx purpureus apice attenuato, dentibus lanceolatis. Lamina purpurea barbulata, $=\frac{1}{2}$ unguis.

This plant, which is a connecting link between the fimbriate and the dentate species, is described from specimens recently sent to Kew, and dated Aug. 1889.

Subsectio 5. *Monerestolon.*

Caulis unicus, ramosus in multos cauliculos glabros. Folia patentia recurva. Calycis dentes acuminati. Petala non contigua, lamina barbulata.

110. D. Libanotis, *Labill. Dec. Pl. Syr.* i. p. 14, t. 4; *Boiss. Fl. Orient.* i. p. 492; *Lindl. Bot. Reg.* t. 1548.

Basi lignosus, suffrutescens, glaucus, 74 centim. Caulis crassus angulatus valde geniculatus stricte corymboso-ramosus. Folia 36 mm., 3–5-nervia lineari-lanceolata canaliculata; radicalia obtusa, vagina folii diam. duplo longiore, caulina acuta, vagina folii diam. æquante. Flores speciosi odorati sæpius geminati. Bracteæ 6 squarrosæ membranaceo-alatæ coriaceæ obovatæ mucronatæ ad dimidium calycem. Calyx dentibus lanceolatis pungentibus 9-nerviis. Lamina reflexa obovato-cuneata alba maculata ad medium in lacinias setaceas multifida, $=\frac{1}{3}$ unguis, area intermedia rhomboidea. Antheræ luteæ. Capsula oblonga.

b. sinaicus, *mihi.*—*Schimp.* exsicc. no. 274.

30 centim. Folia angustiora.

Geogr. limits.— *N.* Tabreez, in prov. Aderbidjan, Persia, 38°.
S. St. Catherine's Peak, on Mt. Sinai, 28°.
E. Ispahan, in prov. Irak-Adjemi, Persia, 52°.
W. Mt. Lebanon, in Syria, 35°.

111. D. SUPERBUS, *Linn. Amœn. Acad.* iv. (1759), p. 272; *Sp. Plantarum*, ed. II. p. 589; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 687; *Reichb. Icon. Fl. Germ. Helv.* f. 5032; *Curt. Bot. Mag.* t. 297.

Glaber læte virens. Caulis 35–50 centim., dichotome et corymbose ramosus, teres, gracilis. Folia 48 mm., lanceolato-linearia basi obtusa superne acuta 3–5-nervia mollia plana, vagina folii diam. æquante. Flores odoratissimi paniculis laxis dichotomis. Bracteæ 4 obovatæ stramineæ membranaceo-alatæ mucronatæ adpressæ ad $\frac{1}{4}$ calycis longit., valde inæquales. Calyx apice attenuato, dentibus lanceolatis purpureis 7-nerviis. Lamina oblongo-cuneata pallide rosea fere ad basin usque pinnatim multifida, $=\frac{1}{2}$ unguis, area oblonga minuta. Antheræ luteo-albæ, ellipticæ. Capsula cylindrica.

b. speciosus, *Reichb. Fl. Germ. Exc.* p. 808; *Schur, Enum. Pl. Transsilvaniæ*, 99 (*var.* grandiflorus); *Reichb. Ic. Fl. Germ. Helv.* 5032 β.

Caulis 30 centim., parce ramosus, pauciflorus. Flores duplo majores, brevius pedunculati, sæpe rubicundi. Calyx purpureus crassior.

c. cæspitosus, *Drejer, Fl. Excurs. Hafniensis* (1838); *auct. Pinks Cent. Eur.* p. 35.

Basi plus minus cæspitosus.

d. micropetalus, *Lange, Haandb. Dansk. Flora*, p. 296; *auct. Pinks Cent. Eur.* p. 35.

e. brevicalycina, *Maxim. in Act. Hort. Petropolit.* xi. (1890).

f. longicalycina, *Maxim. in Act. Hort. Petropolit.* xi. (1890).

g. subobtusus, *Regel et Herd. Enum. Pl. Semenov. in Bull. Soc. Nat. Mosc.* 1866, p. 532.

Caules robusti. Bracteæ ovato-subrotundæ. Calyx purpureus.

Geogr. limits.— *N.* Altenfiörd, in Norway, 70°.
S. Barcelona, 42°.
E. Japan, 142°.
W. Galicia, in Spain, 8°.

As this plant was known to Arnoldus, who includes it in his

"Tunica herba," it may not be out of place here to give a few of the pre-Linnean names by which it was known :—

Caryophyllus minor II. (*Dodonæus*, 1583).
Caryophyllus sylvestris VI. (*Clusius*, 1598).
Superba major flore albo (*G. Pelletier*, 1610).
Tunica montana altissima (*Rupp*, 1718).
Caryophyllus flore tenuissimo dissecto (*Seguier*, Plantæ Veronenses, 1745–1754).
Caryophyllus plumarius (*Kraschennikow*, 1750).
Caryophyllus floribus solitariis, petalis multifidis basi canaliculatis (*J. G. Gmelin*, 1751).
Tunica plumaria (*Scopoli*, 1760).

And the following post-Linnean :—

Caryophyllus superbus (*Moench*, 1794).

112. D. Wimmeri, *Wich. in Verh. d. Schles. Gesellsch.* Jahrg. 1854, p. 75 ; *et in Flora*, 1856, p. 127.

Caulis 35 centim., teres. Folia 48 mm., 3–5-nervia, mollia linearia acuta plana, vagina folii diam. æquante. Flores odorati paniculis laxis dichotomis. Bracteæ 4 obovatæ adpressæ membranaceo-alatæ mucronatæ ad $\frac{1}{4}$ calycis, stramineæ purpurascentes. Calyx rubellus, dentibus lanceolatis 7-nerviis. Lamina obovato-cuneata purpurea fere ad basin usque pinnatim multifida.

Geogr. limits.— *N.* Sweden. *E.* Transylvania.
S. Hungary. *W.* Switzerland.

Sectio ii. Barbulatum.

Flores solitarii vel in ramulis laxe cymosi. Petala dentata, barbulata, rosea purpureave.

Subsectio 1. *Lepidacribia.*

Bracteæ scariosæ, attingentes $\frac{1}{4}$–$\frac{1}{3}$ calycis longitudinem, adpressæ.

* Bracteæ 4–8. Calyx non verruculosus.

113. D. lusitanicus, *Brot. Fl. Lusit.* ii. p. 137 ; *Phytogr. Lusit.* t. 70 ; *Willk. Icon. Descr. Pl. Crit. Hisp.* i. p. 8, t. 2.

Suffrutescens, cæspitosus, glaucus, glaber. Caules 30 centim., teretes furcati 2–4-flori. Folia anguste linearia acuta 3-nervia, radicalia 19 mm. carinata patentia recurva sulcata, caulina 10 mm. canaliculata stricta adpressa, apicem versus cucullato-convoluta, vagina folii diam. æquante. Flores longe pedunculati

inodori. Bracteæ 6 inæquales mucronatæ, superioribus obovatis, 2 infimis lanceolatis. Calyx apice attenuato, dentibus lanceolatis cuspidatis. Petala supra rosea infra pallida non contigua; lamina obovato-cuneata, $=\frac{1}{3}$ unguis. Capsula cylindrica dentibus obtusis.

Geogr. limits.— *N.* R. Douro, 41°.
S. Mt. Atlas, in Morocco, 34°.
E. Aragon, 1° W.
W. Portugal, 8°.

114. D. LUSITANOIDES, *mihi in Journ. of Botany*, 1885, p. 349; *Enum. spp. varr. Dianthus*, p. 15.

Cæspitosus, glaber. Caules 48 centim., ramosi teretes. Folia canaliculata, radicalia linearia acuta, caulina elongato-linearia acuminata stricta adpressa, vagina folii diam. æquante. Bracteæ obovato-lanceolatæ mucronatæ. Calyx dentibus lanceolatis acuminatis purpureis 9-nerviis. Petala non contigua, lamina obovata rosea.—Herb. Palestine Exploration Society.

Hab. East of the river Jordan.

115. D. CÆSPITOSUS, *Thunb. Prodr. Pl. Cap.* p. 81; *Harv. et Sond. Fl. Capensis*, i. p. 122.

Cæspitosus, glaucus, glaber. Caudex crassus. Caules 26 mm., simplices vel furcati teretes. Folia elongato-linearia acuta; radicalia 12 mm., patentia recurva carinata, caulina 6 mm., stricta adpressa plana, supremis subulatis, vagina folii diam. æquante. Bracteæ 6 (rarius 4) inæquales purpureo-marginatæ acutæ, superioribus ovatis, infimis lanceolatis. Calyx 50 mm. tenuissimus, dentibus lanceolatis acuminatis margine membranaceis. Petala contigua; lamina obovata rosea, $=\frac{1}{2}$ unguis. Capsula oblonga.

Hab. Cape Colony.

116. D. CÆSIUS, *Sm. Engl. Botany* (1792), t. 62; *et in Trans. Linn. Soc.* ii. (1794), p. 302; *Engl. Botany*, ed. III. ii. p. 48, t. 193.

Cæspitosus, glaucus, glaber. Caules 22 centim., simplices v. superne furcati stricti 4-angulares 1–2-flori. Folia 3-nervia patentia; radicalia 50 mm., lanceolato-linearia obtusa plana, caulina 36 mm. linearia acuta carinata, vagina folii diam. æquante. Flores speciosi odorati. Bracteæ 4 coriaceæ membranaceo-marginatæ mucronatæ, exteriores obovatæ, interiores subrotundæ.

Calyx purpurascens, dentibus ovato-lanceolatis acutis. Petala contigua; lamina rosea obovato-cuneata irregulariter dentata, $=\frac{1}{2}$ unguis. Antheræ oblongæ. Capsula cylindrica.

b. tenuissimus, *Schur*, *Enum. Pl. Transsilvaniæ*, p. 97; *auct. Pinks Cent. Eur.* p. 36.

Caules graciliter tenuissimi.

c. flaccidus, *Fieb.* (sp.) *in Flora*, 1834, p. 633; *Gren. et Godr. Fl. de France*, i. p. 237.

Folia plana flaccida.

d. macranthus, *Schur*, *Enum. Pl. Transsilvaniæ*, p. 97; *auct. Pinks Cent. Eur.* p. 36.

Flores speciosissimi. Lamina=unguem.

e. biflorus, *mihi.*

Caules semper biflori.

f. pulchellus, *Pers.* (sp.) *Syn.* i. p. 494; *Reichb. Fl. Germ. Exc.* p. 809; *Icon. Fl. Germ. Helv.* f. 5038.

Folia caulina acuminata strictiora rigidula breviora.

g. Henteri, *Heuff.* (sp.) *in Wiegmann's Archiv*, 1852, p. 303.

Geogr. limits.—*N.* Somerset, 51°. *E.* Prussian Silesia, 18°.
S. Dauphiné, 45°. *W.* Somerset, 3°.

This species seems to have been known to Linnæus only from a drawing in Dillenius' 'Hortus Elthamensis.' Ray (1724) seems to have based his name on the unbranched unifloral stems. Specimens with bifloral stems are more frequently found in S. Germany and Switzerland; and on such forms the variety *biflorus* is based. In the 3rd edition of 'English Botany' we find it stated, "flowers solitary, usually only one on the stem;" and in the next parapraph, "flowers generally only one on each stem, more rarely two, $\frac{3}{4}$ inch long, 1 inch across."

117. D. Colensoi, *mihi*, *Enum. spp. varr. Dianthus*, p. 16.

Glaber. Caules 60 centim. 4-angulares. Folia stricta adpressa; radicalia 52 mm., 9-nervia oblongo-lanceolata obtusa, caulina 21 mm. 7-nervia lanceolata acuta plana, vagina folii diam. æquante. Flores solitarii. Bracteæ 6 mucronatæ, exteriores ovato-lanceolatæ, superiores obovatæ. Calyx dentibus lanceolatis acuminatis. Petala non contigua, lamina alba obovata.—Herb. Kew.

Hab. Natal.

118. D. zonatus, *Fenzl, Pugill. Plant. Syr.* no. 35; *Boiss. Fl. Orient.* i. p. 501.

Cæspitosus, scaber, basi suffrutescens. Caules 36 centim., 4-angulares ramosi. Folia stricta; radicalia elongato-linearia acuminata 5-nervia, caulina linearia acuta 7-nervia, vagina folii diam. bis longiore. Bracteæ 4 obovatæ mucronatæ membranaceo-marginatæ. Calyx dentibus lanceolatis mucronatis purpureo-zonatis. Lamina purpurea basi atro-purpureo-zonata subtus flavida obovato-subrotunda ampla, $=\frac{1}{3}$ unguis.

b. oculatus, *Boiss. in Tchihatch. Asie Min. Bot.* i. p. 214, t. 13; *Walp. Ann.* vii. p. 264.

Glaucus. Bracteæ 8. Lamina oblongo-cuneata.

Geogr. limits.—*N.* Ouchak, in Anatolia.
S. Gulek Boghaz, in Cilicia.
E. Marasch, in the Anti-Taurus.
W. Boz-dagh, near Smyrna, in Anatolia.

119. D. microchelus, *mihi* (=D. brachyanthus, *Schur, Enum. Pl. Transsilvanicæ*, p. 96); *Pinks Cent. Eur.* p. 37.

Glaber. Caules 7 centim., tetragoni tenues. Folia oblongo-linearia patentia, radicalia 60 mm. acuminata, caulina 50 mm. acuta angustissima, vagina folii diam. bis longiore. Bracteæ 4 obovatæ mucronatæ fuscæ. Calyx apice attenuato, dentibus lanceolatis acuminatis fuscis. Petala non contigua; lamina purpurea suborbiculata, =unguem.

Hab. Kronstadt, in Transylvania.

So named from the petals having short claws. Schur's name (1866) is pre-occupied by Boissier's *D. brachyanthus* (1839). Blocki thought the plant might be a hybrid between *D. Carthusianorum* and *D. alpinus*, but the latter species is not known in Transylvania.

120. D. maris, *Willd.* ex *Hort. Reg. Kew.*; *auct. Pinks Cent. Eur.* p. 38.

Cæspitosus, glaucus, glaber, 30 centim. Caules teretes paniculatim ramosi. Folia anguste linearia acuminata uninervia patentia, vagina folii diam. æquante. Flores cymis laxis. Bracteæ 4 obovato-rotundatæ mucronulatæ. Lamina pallide rosea subrhomboidea, =unguem.

Hab. The Alps.

This is described from a specimen in flower in the Herbaceous

Ground of Kew Gardens in July 1890. I can find no reference to it by Willdenow, but was assured it was a wild species.

121. D. Szowitzianus, *Boiss. Fl. Orient.* i. p. 503.

Basi suffrutescens, pilosus. Caudex lignosus crassus. Caules 24 centim., stricti râmosi. Folia 25 mm., linearia acuta carinata adpressa uninervia, vagina folii diam. bis longiore. Bracteæ 4 obovatæ mucronatæ. Calyx dentibus lanceolatis acutis 7-nerviis intus velutinis. Petala contigua; lamina obovato-cuneata maculata, =unguem.

Hab. Prov. of Aderbidjan, Persia.

In habit generally resembles *D. rigidus.*

122. D. puberulus, *mihi, in Journ. of Botany*, 1885, p. 344; *Enum. spp. varr. Dianthus*, p. 16.

Puberulus. Caules 24 centim. tenues teretes ramosi, ramulis 1–2-floris. Folia 25 mm. 3–5-nervia, lanceolato-linearia acuta carinata adpressa, vagina purpurea caulis diam. duplo longiore. Bracteæ 8 inæquales ovatæ acuminatæ purpurascentes. Calyx purpureus, dentibus 9-nerviis scarioso-alatis lanceolatis acuminatis. Petala contigua.

Hab. Mt. Sawers in prov. Luristan, W. Persia (*Herb. Kew.*).

Described from specimens collected by Prof. H. K. Haussknecht in 1868.

** Bracteæ 2.

123. D. viridescens, *Vis. Orto Bot. di Padova*, 1842, p. 138; *Walp. Repert.* ii. p. 772; *Vis. Fl. Dalmatica*, iii. p. 163, t. 53.

Nitide viridis, infrà glaber, suprà scaber. Caules 40 centim., 4-angulares ramosi, ramis divergentibus elongatis paniculatis. Folia lineari-lanceolata plana mollia, radicalia acuta 7-nervia, caulina acuminata 5-nervia, vagina folii diam. bis longiore. Bracteæ obovatæ mucronatæ margine scariosæ. Calyx dentibus lanceolatis mucronatis herbaceis purpureis 7-nerviis. Petala contigua, lamina obovata rubra albide maculata subtus virescente.

Hab. Dalmatia.

Fenzl proposed to sink the species in *D. diffusus*, the plates being very similar; but the living plants are quite distinct.

124. D. microlepis, *Boiss. Diagn. Pl. Nov. Or.* ser. 1, i. p. 22; *Fl. Orient.* i. p. 506.

Cæspitosus, nanus, glaber. Folia 15 mm. linearia obtusa canaliculata uninervia mollia, vagina folii diam. æquante. Flores

in cæspite subsessiles. Bracteæ ovato-lanceolatæ albidæ apice virentes acuminatæ. Calyx apice attenuato, dentibus triangularibus acutis rubris ciliolatis 7-nerviis. Lamina obovato-oblonga rosea obtuse dentata, $=\frac{1}{3}$ unguis.

Geogr. limits.— *N.* Servia. *E.* Bulgaria.
S. Rumelia. *W.* Albania.

*** Bracteæ 4. Calyx verruculosus.

125. D. POLYCLADUS, *Boiss. Diagn. Pl. Nov. Or.* ser. 1, i. p. 65; *Fl. Orient.* i. p. 483.

Glabriusculus vel inferne tomentellus. Caules 60 centim., tenues teretes dichotome et stricte ramosi. Folia patentia stricta 3-nervia, radicalia linearia acuta, caulina anguste linearia acuminata, vagina folii diam. bis longiore. Bracteæ obovatæ mucronatæ. Calyx stramineus apice attenuato, dentibus lanceolatis acutis 7-nerviis scarioso-alatis. Lamina pallide carnea parva oblongo-linearis obtuse dentata.

b. breviberbis, *Boiss. MS.*

Omnino glaber. Folia recurva.

Hab. North Syria.

126. D. MULTIPUNCTATUS, *Ser. in DC. Prodr.* i. p. 362; *Boiss. Fl. Orient.* p. 482.

Pubescens, 25 centim. Caules uniflori teretes. Folia anguste linearia acuminata patentia 3-nervia, vagina folii diam. æquante. Bracteæ obovatæ mucronatæ. Calyx apice attenuato, dentibus lanceolato-ovatis acutis 9-nerviis scarioso-alatis. Lamina = unguem, obovato-cuneata rosea.

b. micranthus, *Boiss. herb.*; *auct. Enum. spp. varr. Dianthus*, p. 15.

Velutinus. Flores parvi.

Boissier says of the species, "flores multùm variant magnitudine, laminis plus minus amplis."

c. glabriusculus, *mihi.*

d. pruinosus, *Post, in Journ. Linn. Soc.* xxiv. (1888) p. 422.

Both the above forms occur in Palestine, and are found on the road between Jerusalem and Jericho; whereas the specimens from Mt. Lebanon are more velutinous than in the type and of a brighter green. I have thought it worth while therefore to refer them to the next variety.

e. holosericeus, *mihi*, *Enum. spp. varr. Dianthus*, p. 15.

f. striatellus, *Fenzl* (sp.), *Pugill. Plant. Syr.* no. 33; *Boiss. Fl. Orient.* i. p. 483 (*var.* gracilior).

Caules graciliores. Folia carinata. Lamina purpurea subtus flavo-viridula.

g. subenervis, *Boiss. Fl. Orient.* i. p. 483.

Found on Mt. Lebanon, at a height of 1800 metres.

Geogr. limits.— *N.* Near Tarsus, in Cilicia.
S. Judæa.
E. Mesopotamia.
W. Island of Crete.

**** Bracteæ 10–14.

127. D. AXILLIFLORUS, *Fenzl, Pugill. Plant. Syr.* no. 32; *Boiss. Fl. Orient.* i. p. 483, et *Supplem.* p. 77.

Cæspitosus, scaber. Caules 25 centim., simplices v. superne brevissime et stricte ramosi stricti angulati sulcati. Folia anguste linearia acuminata 3–5-nervia, radicalia flexuosa, caulina adpressa, vagina folii diam. æquante. Flores frequentes speciosi. Bracteæ ovato-ellipticæ membranaceo-marginatæ cuspidato-mucronatæ purpureo-lineatæ arcte imbricatæ, valde inæquales. Calyx apice attenuato, dentibus lanceolatis mucronatis scarioso-alatis 9-nerviis. Petala non contigua, lamina purpurea obovata.

b. heptaneurus, *mihi* (=D. Wawræ, *Freyn*) *in Boiss. Fl. Orient. Supplem.* p. 79.

Folia 7-nervia.

Geogr. limits.— *N.* Cilicia, 37°.
S. Mt. Lebanon, 34°.
E. Mt. Lebanon, 36°.
W. Gulf of Kara-gatch, in Anatolia, 27°.

Subsectio 2. *Hemisyrhix.*

Bracteæ 2–10, attingentes ½ calycis longitudinem.

* Folia patentia, vagina folii diam. æquante, radicalia obtusa.

128. D. DELTOIDES, *Linn. Sp. Plant.* ed. I. p. 411; *Gren. et Godr. Fl. de France*, i. p. 236; *Engl. Bot.* ed. III. ii. p. 43, t. 192.

Cæspitosus, scabro-puberulus. Caules 25 centim., teretes tenues furcati. Folia 12 mm., plana flaccida 3-nervia, nervis lateralibus obscuris, radicalia oblanceolata, caulina lineari-

lanceolata acuta, supremis squamiformibus. Flores breviter pedunculati odorati transverse 18 mm. Bracteæ 2 (rarius 4) ovatæ acutæ patentes coriaceæ membranaceo-marginatæ. Calyx gracilis interdum purpureo-fuscus, dentibus lanceolatis acuminatis scarioso-alatis 7-nerviis sæpe fuscis. Petala non contigua, lamina obovata pallide carnea rosea purpurascens v. rarius alba maculata, $=\frac{1}{2}$ unguis. Antheræ oblongæ purpureæ. Capsula cylindrica. Semina lævia reticulata.

a. typicus (vide *auct. Pinks West. Eur.* p. 23).

Vix glaucescens. Bracteæ 2. Lamina rosea v. purpurascens.

Subvar. alpestris, *Baumg.* (sp.) *ex Schur* (non *var.* alpestris, *Endr. et Hochst.*).

b. microlepis, *Pet.* (vide *auct. Pinks Cent. Eur.* p. 39).

Hab. Saxony.

c. serpyllifolius, *Borb. in Oesterr. Bot. Zeitschr.* 1888, p. 51; *auct. Pinks Cent. Eur.* p. 39.

Magis cæspitosus. Caules magis foliosi. Folia caulina obtusiuscula.

d. glaucus, *Linn.* (sp.) *Sp. Plant.* ed. I. p. 411; *Sm. in Trans. Linn. Soc.* ii. (1794), pp. 295, 300; *Reichb. Icon. Fl. Germ. Helv.* f. 5041.

Valde glaucus. Folia subinde glabra. Bracteæ 4. Lamina alba semper cum linea transversa purpurea ad basin.

Subvar. wolgensis, *Fisch. in Hornem. Hort. Hafn. Supplem.* p. 137; *Ledeb. Fl. Rossica,* i. p. 281 (floribus purpurascentibus).

e. foliosus, *Boenn.* (non *Turcz.*) *in Reichb. Icon. Fl. Germ. Helv.* f. 5040.

Respecting the variation of this species Reichenbach says (Fl. Germ. Excurs. p. 809):—" Gracilis, scaber, petala angusta saturate kermesina, basi albo-punctata. In montanis magis foliosus, glaucescens, floribus majoribus saturatioribus."

Geogr. limits.— *N.* Trondhjem fiord, in Norway, 64°.
S. Bengal, 23°.
E. Japan, 142°.
W. Scotland (Inverness), 5°.

129. D. ALPINUS, *Linn. Sp. Plantarum,* ed. I. p. 412; *Ledeb. Fl. Rossica,* i. p. 281; *Sims, Bot. Mag.* t. 1205.

Plus minus cæspitosus, glaber. Caules 9 centim., simplices

teretes uniflori. Folia radicalia 20 mm. lanceolato-linearia recurva plana, caulina 25 mm. linearia obtusa stricta canaliculata, omnibus uninerviis. Flores speciosi inodori. Bracteæ 2–6, exteriores lanceolatæ interioribus longiores, interiores ovatæ, acuminatæ patentes apice purpureæ. Calyx ventricosus purpureus, dentibus triangularibus acutis. Petala contigua; lamina obovato-cuneata obtuse dentata, supra purpurea, infra viridi-alba maculata, = unguem. Antheræ purpureæ.

a. typicus, *Reichb. Icon. Fl. Germ. Helv.* f. 5036.

Laxe cæspitosus. Bracteæ 4.

b. pavonius, *Tausch* (sp.) *in Flora*, 1839, p. 145; *Walp. Repert.* p. 266.

Dense cæspitosus. Bracteæ 2.

c. Semenovii, *Regel et Herd. Enum. Pl. Semenov. in Bull. Soc. Nat. Mosc.* 1866, p. 531; *auct. Enum. spp. varr. Dianthus*, p. 16.

Dense cæspitosus. Bracteæ 6.

Geogr. limits.—*N. & E.* Coast of the Kara Sea, in Arctic Russia, 70° N., 70° E.
S. Mt. Parnassus, in Greece, 38°.
W. The Swiss Alps, 10°.

130. D. BREVICAULIS, *Fenzl, Pugill. Plant. Syr.* no. 34; *Boiss. Fl. Orient.* i. p. 503.

Cæspitosus, glaber, glaucus. Caules 20 centim., simplices angulati uniflori. Folia flaccida 3-nervia carinata, radicalia lanceolato-linearia, caulina linearia acuta. Bracteæ 4 scariosæ rubræ oblongæ patentes mucronato-cuspidatæ. Calyx rubellus, dentibus obovato-lanceolatis mucronatis. Lamina parva obovata purpurea, $=\frac{1}{3}$ unguis.

Hab. Mt. Taurus, in Cilicia.

131. D. DIFFUSUS, *Sibth. et Sm. Fl. Græca*, iv. p. 85, t. 396; *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 191.

Basi suffrutescens, glaber. Caules 25 centim., ramosi teretes. Folia plana linearia, radicalia 36 mm. mollia 5-nervia, caulina 27 mm. acuta 3-nervia. Flores geminati longe pedunculati. Bracteæ 2 obovatæ mucronatæ adpressæ coriaceæ rubellæ. Calyx dentibus lanceolatis acuminatis ciliolatis. Petala contigua; lamina obovato-cuneata, supra rosea, subtus rubra, parce pilosa, $=\frac{1}{2}$ unguis. Antheræ cæruleæ. Capsula oblonga dentibus obtusis.

b. cylleneus, *Boiss. Diagn. Pl. Nov. Or.* ser. II. i. p. 63; *Fl. Orient.* i. p. 507.

Flores breviter pedunculati. Calyx apice attenuato. Lamina pullior.

Geogr. limits.— *N.* Negropont, in the Grecian Archipelago.
S. & *E.* Cyprus.
W. Morea, in Greece.

132. D. MYRTINERVIUS, *Griseb. Reise Rumel.* 1839, pp. 191, 193; *Boiss. Fl. Orient.* i. p. 506.

Cæspitosus, glaber, nanus. Caules 5 centim. teretes foliosi uniflori. Folia 6 mm. oblongo-linearia obtusa stricta 3-nervia. Bracteæ 2, obovato-lanceolatæ mucronatæ stramineæ adpressæ. Calyx stramineus, dentibus ciliolatis triangularibus mucronatis. Lamina rosea obovata obtuse dentata, $=\frac{1}{2}$ unguis. Antheræ flavæ.

b. oxylepis, *Boiss. Fl. Orient.* i. p. 507; *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 192 (D. deltoides).

Folia superiora acutiuscula.

c. scardicus, *Wettst.* (sp.) *Beitr. Fl. Albaniens*, p. 31, t. 2 (1892).

Calyx purpureo-viridescens, dentibus 7-nerviis. Lamina purpurea deltoideo-spathulata.

Hab. Turkey.

133. D. BUERGERI, *Miq. Prol. Fl. Japon. in Annal. Mus. Lugd. Bat.* ii. p. 77; *Rohrb. in Linnæa*, xxxvi. (1870), p. 674.

Cæspitosus. Caules simplices uniflori. Folia plana uninervia, radicalia 100 mm., lanceolata, caulina 72 mm., lanceolata-linearia acuta. Bracteæ 4 lanceolatæ acuminatæ patentes. Calyx dentibus lanceolatis acuminatis. Lamina spathulata.

Hab. Japan.

Miquel examined only one specimen, collected and dried by a Japanese botanist, so that its specific identity is particularly doubtful and its affinities uncertain. I transcribe it, however, as I find it, though it might be referred, as P. Rohrbach suggests, to *D. deltoides*, which is not recorded by Miquel in Japan.

134. D. NITIDUS, *Waldst. et Kit. Pl. Rar. Hungariæ*, ii. p. 209, t. 191; *Neilr. Diagn. Pl. Hung. Slavon.* p. 22; *Reichb. Icon. Fl. Germ. Helv.* f. 5035.

Cæspitosus, glaber. Radix multiceps. Caules 11 centim. simplices v. apice parce et stricte ramosi teretes nitidi. Folia 24 mm., obtusa uninervia canaliculata nitida, radicalia lineari-lanceolata recurva, caulina linearia incurva. Flores speciosi odorati. Bracteæ 4, herbaceæ rubellæ ovato-lanceolatæ acuminatæ adpressæ. Calyx brevis membranaceus purpureus v. nigricans, dentibus ovato-lanceolatis acutis. Petala non contigua; lamina obovata rosea maculata, $=\frac{1}{2}$ unguis. Antheræ purpureæ.

b. obtusus, *mihi, in Journ. of Botany*, 1885, p. 345; *Enum. spp. varr. Dianth.* p. 17.

Caules apice stricte ramosi. Folia omnia latiora obtusiora lineari-lanceolata. Bracteæ ovato-ellipticæ.—Syria, 1879 (*Herb. Kew.*).

c. sursumscaber, *Borb. in Termesz. Füz.* xii. (1889), p. 41.

Geogr. limits.—*N.* N.W. Carpathians, in the county of Liptau, in Hungary.
S. Jebel Muneitsi, in Syria.
E. Ibid.
W. Rocks on the summit of the Visocica, in Croatia.

135. D. Seidlitzii, *Boiss. Fl. Orient.* i. p. 506.

Cæspitosus, glaber, 8 centim. Caules uniflori. Folia 12 mm., uninervia linearia obtusa flaccida carinata. Bracteæ 4, virenti-rubellæ oblongo-lanceolatæ mucronatæ adpressæ. Calyx ruber valde nervosus apice attenuato, dentibus oblongo-lanceolatis acutis. Lamina obovata, $=\frac{1}{2}$ unguis.

Hab. Prov. of Aderbidjan, Persia.

** Folia adpressa obtusa, vagina folii diam. æquante.

136. D. multisquamatus, *mihi, in Journ. of Botany*, 1885, p. 344; *Enum. spp. varr. Dianth.* p. 16.

Glaber, 52 centim. Caules tenues stricte ramosi teretes. Folia 32 mm., linearia plana stricta 3-nervia basi obscure 5-nervia. Bracteæ 10, obovatæ mucronatæ adpressæ arcte imbricatæ purpureæ valde inæquales. Calyx apice attenuato, dentibus lanceolatis acuminatis scarioso-alatis 7-nerviis purpureis. Lamina oblonga.

Hab. Kurdistan (*Herb. Mus. Brit.*).

Described from specimens received from Prof. H. K. Hausskneeht, and dated 1876.

*** Folia adpressa acuta. Calyx verruculosus.

137. D. GADITANUS, *Boiss. Diagn. Pl. Nov. Or.* ser. II. i. p. 67; *Walp. Ann.* vii. p. 261.

Caules ramosi teretes foliosi. Folia linearia plana, vagina folii diam. æquante. Flores irregulariter corymbosi. Bracteæ 4–6, ovato-oblongæ mucronatæ adpressæ scariosæ. Calyx apice attenuato, dentibus lanceolatis mucronulatis. Lamina obovato-cuneata, $=\frac{1}{3}$ unguis.

a. hispanicus, *mihi.*

Glaber. Folia 5–nervia. Calycis dentes 9-nervii. Lamina rosea.

This is the typical form, as first described by Boissier, and occurs in the woods of Chiclana, near Cadiz.

b. maroccanus, *mihi.*

Glaber. Folia latiora 7-nervia. Calycis dentes 11-nervii. Lamina pallide rosea.

The identity of this form may best be inferred from its synonyms. They are:—D. Hornemanni, *Salzm. Exsicc. in Herb. Kew., non Ser. in DC. Prodr.* i. p. 362; D. glaucus, *Schousb. herb.*; D. Schousbæi, *Coss. ex Ball, et* D. gaditanus, *Ball, Spic. Fl. Marocc., in Journ. Linn. Soc.* xvi. (1877), p. 355.

c. rumelicus, *mihi.*

Cæspitosus, pubescens, 30 centim. Folia 5-nervia. Lamina supra rosea, subtus lutea.

Syn. D. roseo-luteus, *Velen. in Oesterr. Bot. Zeitschr.* 1887 (vide *Nym. Consp. Fl. Eur. Suppl.* ii. p. 58); ut var. *mihi*, *Enum. spp. varr. Dianthus*, p. 16.

This form is found near Aitos, in E. Rumelia.

Geogr. limits.—*N.* Puerto de S. Maria. } Spain.
W. Cadiz.
E. Tetuan. } Morocco.
S. Prov. of Tangier.

**** Folia patentia acuta. Bracteæ mucronatæ.

138. D. PUBESCENS, *Sibth. et Sm. Fl. Græca*, iv. p. 86, t. 397; *Boiss. Fl. Orient.* i. p. 507; *Sweet, Brit. Fl. Gard.* 27.

Glanduloso-pubescens, hispidus. Caules 25 centim., tenues multum ramosi teretes. Folia flaccida plana 3-nervia, inferiora lineari-lanceolata, reliqua linearia, vagina folii diam. æquante. Flores solitarii v. bini longe pedunculati inodori. Bracteæ 2, elliptico-ovales patentes coriaceæ scarioso-alatæ. Calyx villosus, dentibus ovatis subulato-acuminatis purpureis ciliolatis pungentibus. Petala non contigua; lamina oblonga plana, supra rosea maculata, subtus viridi-flavida parce pilosa,=unguem. Antheræ purpureæ.

b. fasciculatus, *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 190; *auct. Pinks Cent. Eur.* p. 39.

Flores breviter pedunculati.

Geogr. limits.—*N.* Mt. Kopaonik, in Servia.
S. Island of Cerigo, in Greece.
E. Karnabad, in Eastern Rumelia.
W. Mt. Œta, in Greece.

139. D. MASMENÆUS, *Boiss. Diagn. Pl. Nov. Or.* ser. II. v. p. 51; *Boiss. Fl. Orient.* i. p. 502.

Velutinus. Caules 22 centim., teretes dichotome ramosi. Folia 20 mm., carinata, inferiora lanceolata 5-nervia, reliqua lanceolato-linearia 3-nervia, vagina folii diam. bis longiore. Flores laxe cymosi, breviter pedunculati. Bracteæ 4, oblongæ pallidæ adpressæ scarioso-alatæ. Calyx scabridus rubellus, dentibus lanceolatis acuminatis pungentibus ciliolatis. Petala non contigua; lamina obovato-cuneata, supra rosea, subtus flavida, parce pilosa, $=\frac{1}{4}$ unguis.

b. glabrescens, *Boiss. Fl. Orient.* i. p. 502; *et in Ann. Sci. Nat.* ser. 4, ii. (1854), p. 244, t. 2; *Tchihatch. Asie Min. Bot.* i. p. 212, t. 12 (D. mutabilis).

c. Karami, *Blanche, in Boiss. Fl. Orient. Supplem.* p. 80.

Folia flaccidiora. Bracteæ semi-herbaceæ margine rubellæ. Calyx viridis dentibus sanguineis.

d. œtæus, *Heldr.* (sp.), ex *Boiss. Fl. Orient. Supplem.* p. 80.

Geogr. limits.—*N.* Masmeneu-Dagh, in Kurdistan.
S. Cilicia.
E. Prov. of Diarbekir.
W. Mt. Œta, in Greece.

140. D. VERSICOLOR, *Fisch. in Link, Enum. Hort. Berolin.* i. p. 420; *DC. Prodr.* i. p. 358; *Reichb. Hort.* t. 48.

Glaber. Caules 25 centim., teretes paniculatim ramosi. Folia anguste linearia plana, radicalia 37 mm. recurva, caulina 20 mm. incurva, supremis squamiformibus, vagina folii diam. æquante. Flores laxe paniculatim dispositi. Bracteæ obovatæ patentes membranaceæ basi rubræ. Calyx dentibus lanceolatis acutis. Petala non contigua ; lamina obovato-cuneata, supra rubra maculata, subtus viridi-flavicante, = unguem. Antheræ cæruleæ.

Hab. Altai Mtns., in Siberia.

141. D. ELATUS, *Ledeb. Fl. Altaica*, ii. p. 136 ; *Fl. Rossica*, i. p. 280 ; *Ic. Pl. Fl. Rossic.* 420.

Pilosus. Caules 36 centim., tetragoni superne dichotome ramosi. Folia anguste linearia plana, radicalia recurva, caulina incurva, vagina folii diam. æquante. Bracteæ 6 ovatæ patentes membranaceæ. Calyx dentibus lanceolatis acutis ciliolatis. Lamina ovalis purpurea.

Hab. Altai Mtns., in Siberia.

***** Folia omnia acuta v. acuminata, patentia. Bracteæ acuminatæ.

142. D. HYPOCHLOROS, *Boiss. et Heldr. Diagn. Pl. Nov. Or.* ser. I. viii. p. 67 ; *Boiss. Fl. Orient.* i. p. 502.

Pumilus, cæspitosus, velutinus. Caules 15 centim., tenues tetragoni subsimplices v. superne parce et stricte ramosi, 1–3-flori. Folia anguste linearia acuta 3-nervia, radicalia 25 mm. canaliculata stricta, caulina 20 mm. plana flaccida, vagina folii diam. duplo longiore. Bracteæ 4 ovatæ stramineæ albo-marginatæ adpressæ. Calyx dentibus triangularibus acutis rubris scarioso-alatis ciliolatis. Petala contigua ; lamina oblongo-spathulata, supra carnea, subtus flavida, $=\frac{1}{2}$ unguis.

Hab. Anatolia and Karamania.

143. D. ARIDUS, *Griseb. ap. Janka, in Oesterr. Bot. Zeitschr.* xxxiii. (1873), p. 196 ; *Boiss. Fl. Orient., Suppl.* 79.

Glaber. Caules simplices diffusi. Folia 25 mm. anguste linearia acuminata flaccida uninervia v. obsoletius 3-nervia, vagina folii diam. æquante. Flores speciosi laxe fasciculati. Bracteæ 4 ovatæ patentes pallidæ subherbaceæ. Calyx dentibus oblongo-lanceolatis acutis scarioso-alatis. Lamina obovata leucantha, subtus viridula v. purpurascens, $=\frac{1}{3}$ unguis.

Hab. Eastern Rumelia.

144. D. CAMPESTRIS, *Bieb. Fl. Taur. Cauc.* i. p. 326; *Trautv. Enum. Pl. Songoric. in Bull. Soc. Nat. Mosc.* 1860, i. p. 141; *Bot. Mag.* t. 1876.

Glaber vel lanatus, basi suffrutescens. Caules tenues foliosi sæpius laxe et divaricatim paniculati. Folia anguste linearia flaccida 3-nervia, radicalia plana, caulina canaliculata, vagina folii diam. æquante. Bracteæ 4 ovato-oblongæ adpressæ, scarioso-alatæ. Calyx dentibus lanceolatis acuminatis ciliolatis. Petala non contigua; lamina obovato-cuneata, supra maculata, subtus ochroleuca, $=\frac{1}{3}$ unguis.

a. pubescens, *Trautv. Enum. Pl. Songoric. in Bull. Soc. Nat. Mosc.* 1860, pt. i. p. 141.

Lanatus, 20 centim. Folia acuminata. Lamina supra purpur. a.

forma *α*. *Bieb. Fl. Taur. Cauc.* i. pp. 326, 427, iii. p. 298.

Caulis basi simplex pubescenti-scaber. Bracteæ subaristatæ.

forma *β*. *Bieb. Fl. Taur. Cauc.* i. p. 326.

Caulis basi ramosus subdichotomus minus pubescens.

forma *γ*. *Bieb. Fl. Taur. Cauc.* i. p. 326; *Cent. Plant. Rar. Ross.* i. t. 8.

Caulis basi ramosus flaccidus. Omnino hirsuta.

b. glabra, *Trautv. Enum. Pl. Songoric. in Bull. Soc. Nat. Mosc.* 1860, pt. i. p. 142; *Ser. in DC. Prodr.* i. p. 358 (D. pallidiflorus); *Ledeb. Ic. Plant. Fl. Ross.* 197 (D. ramosissimus).

Glaber, 50 centim. Folia acuta. Lamina rosea.

Geogr. limits.—*N.* Guberlinsk, in the Ural Mountains, 55°.
S. Beschbarmak, in Transcaucasia, 41°.
E. Desert of Soungaria, in S.W. Siberia, 75°.
W. Prov. of Podolia, in Russia, 27°.

145. D. ARISTATUS, *Boiss. in Tchihat. Asie Min. Bot.* i. p. 222; *et in Fl. Orient.* i. p. 505.

Velutinus, basi suffrutescens. Caules 20 centim., teretes parce ramosi. Folia anguste linearia acuta stricta 3-nervia canaliculata, vagina folii diam. æquante. Bracteæ 6, oblongæ stramineæ scarioso-alatæ. Calyx dentibus lanceolatis acutis scarioso-alatis. Lamina obovato-cuneata rosea, subtus flavida, $=\frac{1}{3}$ unguis.

b. minor, *Boiss. Fl. Orient.* i. p. 505.

Caules sæpe uniflori.

c. pulverulentus (*Stapf*), *Bot. Polak. Exped. Pers.* p. 11.

Vagina folii diam. duplo longiore. Calyx apice attenuato.

Geogr. limits.—*N.* Prov. of Van, in Asia Minor.
S. Persia.
E. Persia.
W. Prov. of Anatolia.

146. D. HUMILIS, *Willd. Herb.* no. 8548, *ex Ledeb. Fl. Rossica*, i. p. 280; *Boiss. Fl. Orient.* i. p. 505.

Dense cæspitosus, hispidus, 14 centim. Caules numerosi tenues uniflori. Folia rigida setacea acuta pungentia carinata 3-nervia, vagina folii diam. æquante. Bràcteæ 6 oblongæ adpressæ scarioso-alatæ. Calyx dentibus lanceolatis acutis 7–9-nerviis. Lamina obovato-cuneata rosea, $=\frac{1}{3}$ unguis.

Hab. S. Russia.

147. D. CALLIZONUS, *Schott et Kotschy, in Bot. Zeitung*, 1851, p. 192; *Baumg. Enum. Stirp. Transsilv.* i. (1816), p. 390 (D. nitidus).

Glaucus, glaber. Caules 36 centim., uniflori teretes. Folia canaliculata 3–5-nervia, radicalia lineari-lanceolata acuta, caulina lanceolato-linearia acuminata, vagina folii diam. æquante. Bracteæ 4 lanceolatæ patentes purpurascentes. Calyx purpureus, dentibus lanceolatis acuminatis. Lamina obovato-cuneata, supra purpurea maculata, infra rosea, = unguem.

b. Brandzæ, *Panč.* (sp.), *in Kern. Sched. Fl. Austro-Hung.*; *auct. Pinks Cent. Eur.* p. 42.

Caules tenues. Bracteæ obovatæ acutæ. Lamina subintegra.

Hab. Transylvania and Wallachia.

Subsectio 3. *Longisquamea.*

Bracteæ subfoliaceæ, attingentes basin dentium calycis vel calycem superantes; patentes.

148. D. PRUINOSUS, *Boiss. et Orph. Diagn. Pl. Nov. Or.* ser. II. vi. p. 28; *Walp. Ann.* vii. p. 266.

Scaber, glaucus, 20 centim. Caudex procumbens. Caules tetragoni parce ramosi. Folia anguste linearia acuminata incurva patentia carinata, vagina folii diam. duplo longiore. Flores solitarii v. bini. Bracteæ 4–6 lanceolatæ mucronatæ margine anguste membranaceæ. Calyx apice attenuato, dentibus lanceolatis acuminatis ciliolatis 9–11-nerviis. Lamina obovato-cuneata rosea maculata, $=\frac{1}{2}$ unguis.

b. purpureo-luteus, *Velen.* (sp.), *ex Nym. Consp. Fl. Eur., Supplem.* ii. p. 57.

Lamina supra purpurea, infra lutea.

Hab. Thessaly and Eastern Rumelia.

149. D. PRATENSIS, *Bieb. Fl. Taur. Cauc.* iii. p. 300; *DC. Prodr.* i. p. 358.

Glaber. Caules 33 centim., corymbose ramosi 4-angulares. Folia stricta 3-nervia, radicalia linearia obtusa, caulina lanceolata acuta plana, vagina folii diam. æquante. Bracteæ 4, exteriores lanceolatæ, interiores obovatæ acuminatæ calycem superantes. Calyx apice attenuato, dentibus lanceolatis obtusis. Petala contigua, lamina obovato-cuneata purpurea maculata. Semina granulata.

b. guttatus, *Bieb.* (sp) *Fl. Taur. Cauc.* iii. p. 300; *DC. Prodr.* i. p. 358; *Reichb. Ic. Plant. Crit.* 654.

Cæspitosus. Bracteæ ovatæ acutatæ ad basin calycis dentium.

c. acrochlorus, *Stapf* (sp.), *Beitr. Fl. Lycien*, ii. p. 6.

Caules inferne scabriusculi. Vagina folii diam. æquante. Calyx purpurascens, dentibus triangularibus acutis.

Geogr. limits.—*N.* Kherson, in South Russia.
S. Anatolia, in Asia Minor.
E. Kherson, in South Russia.
W. Dobrudscha, in Roumania.

150. D. SUAVEOLENS, *Spreng. Syst. Veg.* ii. p. 379.

Glaber, glaucus. Caules 25 centim., corymbose ramosi 4-angulares. Folia stricta acuta patentia; radicalia 25 mm. lanceolata, caulina 12 mm. linearia, vagina folii diam. æquante. Bracteæ 4 inferiores lanceolatæ superiores obovatæ, mucronatæ calycem superantes. Calyx dentibus lanceolatis mucronatis. Petala contigua; lamina obovato-cuneata maculata, = unguem.

Hab. Siberia.

151. D. GELIDUS, *Schott, Nym. et Kotschy, Analecta Botan.* (1854), p. 54; *et in Oesterr. Bot. Wochenbl.* 1856, p. 37.

Cæspitosus, glaber. Caules 8 centim., simplices 4-angulares. Folia linearia obtusa uninervia plana patentia recurva, vagina folii diam. æquante. Bracteæ 6, infimæ lanceolatæ, reliquæ ovatæ, acuminatæ recurvæ. Calyx apice attenuato rubellus, dentibus

acuminatis membranaceis. Petala non contigua, lamina rosea maculata obovato-cuneata, = unguem.

Hab. Transylvania and Wallachia.

152. D. GLACIALIS, *Haenke, in Jacq. Collectanea*, ii. (1788), p. 84; *Tanfani, in Parl. Fl. Italiana*, ix. p. 269; *Reichb. Fl. Germ. Exc.* p. 808; *Ic. Fl. Germ.* f. 5037.

Cæspitosus, glaber. Caules 10 centim., simplices 4-angulares 1–2-flori. Folia patentia 3-nervia, radicalia lineari-lanceolata obtusa, caulina 36 mm. linearia acuta stricta vel recurva, vagina folii diam. duplo longiore. Flores inodori. Bracteæ 2–4, rubellæ valde inæquales scarioso-alatæ, exteriores lanceolatæ, interiores ovatæ. Calyx fusco-purpureus, dentibus triangularibus obtusis scarioso-alatis. Petala contigua; lamina purpurea subtus flavicante obovato-cuneata, = unguem. Antheræ ellipticæ cærulescentes. Capsula cylindrica. Semina granulata.

a. typicus (in Helvetia, Lombardia, et Carinthia occurrens). Folia canaliculata. Bracteæ 2.

b. neglectus, *Lois.* (sp.), *Not. Pl. Fl. France* (1810), p. 65; *Gaud. Fl. Helvetica*, iii. p. 160 (D. glacialis); *Reichb. Fl. Germ. Exc.* p. 808; *Ic. Fl. Germ. Helv.* f. 5034.

Folia plana. Flores rarius geminati. Bracteæ 4. Calyx coriaceus. Petala non contigua.

c. alpinus, *Vill.* (sp.) *Hist. Pl. Dauph.* iii. (1789), p. 600; *Sturm, Deutsch. Fl.* Heft 28.

Folia canaliculata. Bracteæ 4. Petala vix contigua.

d. Freynii, *Vandas* (sp.), *in Sitzungsb. k. Boehmisch. Gesellsch. Wissensch.* 1890, i. p. 255.

Folia flaccidula carinata 15 mm., nervis lateralibus obscurioribus. Caules semper uniflori. Bracteæ ovato-oblongæ. Calycis dentes ciliolati.

e. subalpestris, *Gaud. Fl. Helvetica*, iii. p. 160.

Forma pumila.

Geogr. limits.—*N.* The Carpathians, in Galicia, 48°.
S. The Pyrenees (Spanish side), 42°.
E. Transylvania (county of Hermannstadt), 25°.
W. The Pyrenees (central), 0°.

153. D. SINENSIS, *Linn. Sp. Plantarum*, ed. I. p. 411, ed. II. p. 588; *Hort. Upsal.* p. 104; *DC. Prodr.* i. p. 359; (sensu latiore), *Rohrb. in Linnæa*, xxxvi. (1870), p. 670; *Regel, in Bull.*

Soc. Nat. Mosc. 1861, iv. p. 524; *Hemsl. in Journ. Linn. Soc.* xxiii. (1886), p. 63; *mihi, Pinks West. Eur.* p. 29; *Bot. Mag.* t. 25, et t. 5536; *Fl. des Serres*, t. 1150, t. 1288, t. 1289, t. 1380, et t. 1381; etiam vide *Tournef. in Act. Par.* 1705, p. 348, t. 5. (D. chinensis, *auctt. citt. plurim.*)

Cæspitosus, glaber. Caudex repens. Caules dichotome ramosi tetragoni præsertim basi. Folia lineari-lanceolata acuminata basi contorta stricta patentia canaliculata trinervia vel 5-nervia (lateralibus obscurioribus), vagina folii diam. æquante, radicalia 64 mm., reliqua 40 mm. Flores solitarii in paniculis v. cymis laxe dispositi, vix odorati. Bracteæ 4, paribus inæqualibus, ovali-lanceolatæ acuminatæ. Calyx dentibus triangularibus 7-nerviis. Petala contigua; lamina in forma variabili, sæpius rosea, purpurascente, interdum alba, maculata, margine incurva. Antheræ cæruleæ v. purpurascentes. Capsula ovoidea subsessilis. Semina granulata.

b. asper, *Koch* (= D. Seguieri, *auct. Europ.*), *Syn. Pl. Germ. Helv.* (ed. I.), p. 96; *Chaix, in Vill. Hist. Pl. Dauph.* i. p. 330 (in parte, etiam vide D. collinus); *Maxim. Fl. Asiæ Or. Fragm.* p. 6; *Reichb. Ic. Fl. Germ. Helv.* f. 5024; [*Seg. Pl. Ver.* (1745–1754), 18, t. 2 (non bona),] uti D. Carthusianorum, *var.* longifolius; *Timb. Monogr. Dianth. Pyr. Fr.* p. 9, t. 7.

Flores in paniculis dispositi. Bracteæ squarroso-patulæ.

c. sylvaticus, *Koch, Syn. Pl. Germ. Helv.* ed. I. p. 96; *Rohrb. in Linnæa*, xxxvi. (1870), p. 671.

Flores in paniculis dispositi, aut caulis uni- vel pauciflorus. Bracteæ foliaceæ subadpressæ.

subvar. α. macrolepis, *Rohrb.*—Folia sæpe glaucescentia, lineari- vel plus minusve late lanceolata. Flores magni. Bracteæ calycem superantes.

subvar. β. brachylepis, *Rohrb.*—Flores minores, interdum albi. Bracteæ subulato-acuminatæ ad basin calycis dentium, late ovatæ. Lamina obovato-cuneata, = unguem.

d. geminiflorus, *Koch, Syn. Fl. Germ. Helv.* ed. I. p. 96; *Lois. Fl. Gall.* i. p. 305 (1806); *Timb. Monogr. Dianth. Pyr. Fr.* p. 10, t. 8.

Flores geminati. Bracteæ valde striatæ attingentes ad basin calycis dentium. Lamina rosea subrhomboidea, = unguem.

e. macrosepalus, *Franch. Pl. David.* p. 45; *Lessing, in Linnæa*, ix. p. 153 (D. dentosus); *Fisch. ex Reichb. Ic. Pl. Crit.* nn. 743, 744 (D. dentosus).

Geogr. limits.—*N.* Coast of the Kara Sea, in Arctic Russia, left bank of R. Kara, 70°.
S. Near the mouth of the R. Mecon, in Cochinchina, 10°.
E. Near Hakodate, in Jesso, the northern island of Japan, 142°.
W. North Portugal, 8° W.

The reasons for joining the European *D. Seguieri* with *D. sinensis* have been discussed elsewhere. The Linnean description of this pink is obscure and insufficient. Linnæus says of the petals:—"corollæ crenatæ, subtus subvirescentes, supra sanguineæ, margine incarnato, annulo centrali nigro crenato." The ambiguity as to the bearded condition of the lamina of the petals has misled me into referring it hitherto to the wrong group. In none of the accessible descriptions of the plant is this character noticed, and in such reliable dried specimens as are available it is impossible to tell. It was only after coming across accidentally a paper "Ueber *Dianthus*-Bastarde," by P. Ascherson (in Sitzungsb. Gesellsch. naturf. Freunde Berl. 1877, p. 178), that I decided ultimately to place it among the species with bearded petals. In this paper the learned author emphasizes the diagnosis between *D. sinensis* and *D. Caryophyllus* by various minor characters, including the bearded condition of the petals; though apparently, under cultivation, this capillary outgrowth becomes evanescent. The species is extensively figured, but generally in a semi-cultivated state, or as a degenerated florists' flower.

154. D. ERINACEUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 21; *Fl. Orient.* i. p. 498.

Cæspitosus, basi suffruticosus, dumuloso-erinaceus, 20 centim. Caules simplices stricti 1–2-flori. Folia 20 mm., subulata pungentia patentia carinata, vagina folii diam. 3-plo longiore. Bracteæ 8–10 ovatæ acuminatæ calycem superantes. Calyx rubellus apice attenuato, dentibus lanceolatis acutis scarioso-marginatis ciliolatis. Lamina obovato-cuneata rosea, subtus flavescens.

b. Webbianus, *Parol.* (sp.) *in Vis. Illustr. Or. ex Mem. Ist. Venet.* p. 21, t. 3; *Walp. Repert.* ii. p. 772.

Minor. Caules uniflori. Folia lanceolato-linearia squarrosa canaliculata. Bracteæ ovales vel obovatæ cuspidatæ calycem subæquantes. Calyx dentibus acuminatis. Lamina spathulata.

Hab. Anatolia, in Asia Minor.

Sectio iii. CARYOPHYLLUM.

Caules glabri. Bracteæ adpressæ. Calyx dentibus lanceolatis. Petala dentata, imberbia. Capsula ovoidea v. oblonga, nunquam cylindrica.

Subsectio 1. *Caryophylloides.*

Folia patentia. Calyx dentibus acuminatis. Capsula ovoidea.

155. D. CARYOPHYLLUS, *Linn. Sp. Plantarum*, ed. I. p. 411, ed. II. p. 587; *Cod.* no. 3209; *Syme, Engl. Botany*, ed. III. ii. p. 49, t. 194; *Gren. et Godr. Fl. de France*, i. p. 239; *Lam. Fl. Franç.* ii. p. 536, *et Illustr.* t. 376 (D. coronarius); *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 687; *Reichb. Fl. Germ. Exc.* p. 811; *Icon. Fl. Germ. Helv.* f. 5051; *Timb. Monogr. Dianth. Pyr. Fr.* p. 21, t. 27.

Cæspitosus, glaucus, glaber; anno secundo, rhizomate turiones atque stolones repentes foliorum fasciculo terminatos caulem floriferum producentes edente. Caules 60–70 centim., apicem versus paniculato-ramosi (raro simplices) plus minus angulati valde nodosi. Folia crassa obtusa canaliculata 5-nervia, apicem versus rigidiuscula basi plus mollia, nervo centrali prominente lateralibus invalidis, marginibus vix scabridis; radicalia 92–98 mm. longissima, caulina 70–75 mm. linearia recurva, superne decrescentia, summis bracteiformibus; vagina folii diam. duplo longiore. Flores solitarii speciosi odoratissimi dimorphici, rosei purpurei aut albi, longe pedunculati. Bracteæ 4, obovatæ vel fere obcordatæ, acumine mucronato herbaceo ad $\frac{1}{4}$ calycis tubi longitudinem, coriaceæ margine læves. Calyx 24 mm. lævis, apice attenuato, dentibus anguste scarioso-alatis ciliolatis 9-nerviis. Petala contigua; lamina obovato-cuneata vel sub-rhomboidea truncata inæquali-dentata, $= \frac{1}{2}$ unguis. Stamina stylis longiora vel breviora; antheris oblongis. Semina peltata granulata.—Formarum omnium hic typus generis.

a. genuinus, *Linn.*

Cæspitosus, glaber. Petala contigua.

b. Scheuchzeri, *Jord.* (sp.) *Pugill. Plant.* 29; *Reichb. Fl. Germ. Exc.* p. 810; *Icon. Fl. Germ. Helv.* f. 5048.

Laxe cæspitosus. Petala non contigua.

c. collivagus, *Jord.* (sp.) *in Billot, Annot. Fl. de France*, p. 45.

Vix cæspitosus. Habitu minor; 30 centim.

d. carduinus, *Ser. in DC. Prodr.* i. p. 359.

Vix cæspitosus, scabridus.

e. pygmæus, *Bert. Fl. Italica,* iv. p. 553; *Tanfani in Parl. Fl. Italiana,* ix. p. 283.

Caules minores uniflori.

Geogr. limits.—N. & W. Normandy. *S. & E.* Punjaub.

156. D. CARYOPHYLLOIDES, *Schult., ex Reichb. Fl. Germ. Exc.* p. 811; *auct. Pinks West. Eur.* p. 28; *Reichb. Ic. Fl. Germ. Helv.* f. 5050.

Cæspitosus, glaucus. Caules 30 centim., ramosi tetragoni pauciflori. Folia anguste linearia obtusa canaliculata stricta 5-nervia, nervis lateralibus invalidis, radicalia 124 mm. longissima, caulina 100 mm., suprema bracteiformia, vagina folii diam. æquante. Flores geminati inodori. Bracteæ 4 mucronulatæ ad $\frac{1}{5}$ calycis longit. truncatæ scariosæ, exteriores ovales, interiores obovatæ. Calyx apice attenuato, dentibus rubris 7-nerviis. Petala contigua; lamina obovato-cuneata saturate rubra fere kermesina, $=\frac{1}{3}$ unguis. Antheræ oblongæ violaceæ. Semina granulata.

Geogr. limits.—N. Carinthia, 47°.
S. Catalonia, 42°.
E. Transylvania, 25°.
W. Pyrenees (French), 1° W.

157. D. LONGICAULIS, *Ten. Fl. Napolitana,* ii. p. 379, iii. t. 138. fig. 1, iv. p. 206; *Timb. Monogr. Dianth. Pyr.* p. 22, t. 29 (D. Godronianus, *var.* ramosus); *Reichb. Ic. Fl. Germ. Helv.* f. 5052.

Cæspitosus. Caules 48 centim., ramosi tetragoni, internodis longis. Folia longissima gracilia anguste linearia acuminata carinata, radicalia 204 mm. flaccida 7-nervia, caulina 160 mm. stricta 5-nervia, vagina folii diam. æquante. Flores geminati odorati. Bracteæ 6 orbiculares similares mucronatæ ad $\frac{1}{4}$ calycis coriaceæ. Calyx apice attenuato, dentibus purpureis. Petala non contigua; lamina obovato-cuneata rosea, $=\frac{1}{2}$ unguis. Antheræ cæruleæ. Semina lævia.

Geogr. limits.—N. North Italy, 46°.
S. Dalmatia, 41°.
E. Croatia, 17°.
W. Pyrenees (French), 1° W.

158. D. Boissieri, *Willk. Ic. Descr. Pl. Nov. Hisp.* i. (1853), p. 22, t. 13; *Boiss. Voy. Bot. Espagne*, p. 85 (D. sylvestris).

Glaucus. Caules 38 centim., teretes stricti uniflori v. frequentius biflori. Folia anguste linearia acuminata 3-nervia stricta carinata, vagina caulis diam. 3-plo longiore, basilaria 100 mm., cetera 60 mm. Bracteæ 6 obovatæ mucronatæ ad $\frac{1}{3}$ calycis partem. Calyx dentibus 9–11-nerviis. Petala non contigua; lamina obovato-cuneata truncata inæquali-dentata rosea, $= \frac{1}{4}$ unguis. Stamina vittata; antheris luteis ellipticis.

Geogr. limits.—*N.* Sierra Morena, 38°.
S. Prov. Cadiz, in Spain, 36°.
E. Japan, 142°.
W. Prov. Algarve, in Portugal, 9°.

159. D. multinervis, *Vis. Fl. Dalmat.* iii. p. 164, *Supplem.* t. 9; *auct. Pinks Cent. Eur.* p. 44.

Glaucus, basi suffrutescens. Caules 40 centim., ramosi 4-angulares foliosi. Folia lineari-lanceolata acuminata plana (7- vel) 9-nervia, radicalia 72 mm., caulina 66 mm., vagina pallida folii diam. æquante. Bracteæ 4 orbiculares mucronatæ ad $\frac{1}{3}$ calycis tubum stramineæ. Calyx apice attenuato, dentibus 9–11-nerviis. Petala contigua; lamina rubra obovato-cuneata, $=\frac{1}{2}$ unguis. Antheræ cæruleæ.

Hab. The Island of Pomo, off the coast of Dalmatia.

160. D. Arrostii, *Presl, Fl. Sicula*, p. 146; *Tanfani in Parl. Fl. Italiana*, ix. pp. 283, 288.

Cæspitosus, glaucus. Caules 34 centim., 4-angulares uniflori. Folia 3-nervia canaliculata stricta; radicalia elongato-linearia acuminata 56 mm., caulina linearia acuta 24 mm., vagina folii diam. æquante. Flores speciosi. Bracteæ 4 mucronatæ ad $\frac{1}{4}$ calycis tubum minutæ orbiculares stramineæ. Calyx dentibus 9-nerviis ciliolatis. Petala contigua; lamina obovato-cuneata rosea, $=\frac{1}{3}$ unguis. Antheræ oblongæ cærulescentes.

a. uniflorus, *Presl.*

b. biflorus, *Presl.*

c. contractus, *Jan, ex Nym. Consp. Fl. Eur.* p. 105; *Pojero, Fl. Sic.* i. t. 17 *β*.

Geogr. limits.—*N.* Dalmatia. *E.* Dalmatia.
S. Sicily. *W.* Central Italy.

161. D. Falconeri, *Edgew. in Hook. f. Fl. Brit. Ind.* i. p. 214.

Caules ramosi. Folia 100 mm., linearia canaliculata, radicalia 3-nervia, caulina 1-nervia, vagina folii diam. æquante. Bracteæ 4 ovales mucronatæ ad $\frac{1}{4}$ calycis. Calyx 50 mm., dentibus 9–11-nerviis. Petala contigua rosea. Semina lævia.

Hab. Cashmere.

162. D. crenatus, *Thunb. Prodr. Pl. Cap.* p. 81; *Harv. et Sond. Fl. Capensis*, i. p. 123; *Bot. Reg.* t. 256.

Caules 30 centim., stricti ramosi, inferne tetragoni, superne teretes. Folia inferiora quaternatim subverticillata inferne subimbricato-approximata angustissime linearia acuminata strictiuscula carinata 3-nervia 48 mm., reliqua acuta subulata brevia, supremis squamiformibus, vagina folii diam. æquante. Flores vespere odorati. Bracteæ 6 ovato-lanceolatæ acuminato-cuspidatæ ad $\frac{1}{3}$ calycis tubum, inferne scarioso-coriaceæ, superne purpurascentes. Calyx dentibus purpureis scarioso-alatis. Petala non contigua; lamina obovato-cuneata albicante, rubore obsolete suffusa, concolori, laciniato-crenata, $=\frac{1}{3}$ unguis. Antheræ oblongæ ochroleucæ.

Geogr. limits.—*N.* Transvaal. *S.* Kaffraria.

163. D. subacaulis, *Vill. Hist. Pl. Dauph.* iii. (1789), p. 597; *Gren. et Godr. Fl. de France*, i. p. 235; *Lois. Not. Pl. Fl. France* (1810), p. 66, t. 6; *Willk. Ic. Descr. Pl. Nov. Hisp.* i. (1853), p. 11, t. 5 (D. brachyanthus, *var.* ruscinonensis).

Cæspitosus, glaucus. Caudex multiceps. Caules 8 centim., simplices biflori tetragoni. Folia canaliculata 3-nervia, radicalia 24 mm. linearia acuta recurva, caulina 22 mm. elongato-linearia acuminata stricta, vagina caulis diam. æquante. Flores geminati, parvi. Bracteæ 4 scariosæ minutæ purpureo-marginatæ mucronatæ ad $\frac{1}{5}$ calycis, inferiores lanceolatæ, superiores obovatæ. Calyx purpureus apice attenuato, dentibus scarioso-alatis ciliolatis. Petala non contigua; lamina obovato-cuneata purpurea, subtus pallida, = unguem. Antheræ oblongæ cæruleæ. Semina lævia.

Geogr. limits.—*N.* Near Buis, in Dauphiny.
S. Sierra Nevada.
E. Mt. Ventoux, in Dauphiny.
W. Mountains of Asturias.

Subsectio 2. *Sylvestres.*

Caules tenues. Bracteæ mucronatæ. Capsula oblonga.

* Bracteæ scariosæ. Calyx striatus.

164. D. SYLVESTRIS, *Wulf. in Jacq. Collectanea*, i. p. 237; *Jacq. Ic. Plant. Rar. Schönbr.* t. 82; *mihi* (sensu latiore), *Pinks West. Eur.* p. 31; *Reichb. Ic. Fl. Germ. Helv.* 5039; *Jacq. Fl. Austr., App.* t. 15 (D. virgineus).

Cæspitosus. Caules simplices v. ramosi, angulariter compressi. Folia 3-nervia, vagina folii diam. æquante. Flores solitarii inodori. Bracteæ orbiculares truncatæ $\frac{1}{4}$ calycis longit. Calycis dentes mucronulati scarioso-alati. Petala contigua; lamina rosea obovato-cuneata, = $\frac{1}{2}$ unguis. Semina granulata.

varr. prox. D. sylvestris, *Wulf.*—Caules uniflori. Folia flaccida. Flores in caule rarius geminati, longe pedunculati.

a. Forma typica, *Wulf.*; vide *Reichb. Fl. Germ. Exc.* p. 809. 40 centim. Caules geniculis purpureis. Folia linearia acuminata recurva, vaginis rubellis, radicalia 60 mm., reliqua 13–14 mm. Bracteæ 4 purpureo-marginatæ. Calycis dentes 9-nervii. Lamina saturate persicina subkermesina. Antheræ oblongæ.

b. brachycalyx, *Huet, Neap.* n. 278; *Nym. Consp. Fl. Europ.* 105.

Bracteæ 6. Calycis dentes 7-nervii acutiusculi.

Hab. District of Naples.

c. tergestinus, *Reichb. Ic. Fl. Germ. Helv.* f. 5049; *Schloss. et Vukot. Fl. Croat.* 186 (D. longicaulis).

Hab. Croatia and Dalmatia.

d. brevicalyx, *Beck* (sp.) *in Annal. Mus. Vindobon.* 1887; *Nym. Consp. Fl. Eur., Supplem.* ii. p. 60.

Bracteæ 6. Calyx brevis apice subangustatus.

Hab. Bosnia.

e. pratensis, *Jord.*

Folia incurva carinata, radicalia 148 mm., caulina 50 mm. Flores binati. Bracteæ 4.

Hab. Central France.

f. nodosus, *Tausch* (sp.), *Syst. Pl. Nov. in Flora*, 1828, p. 243; *Walp. Repert.* i. p. 267.

Caules valde geniculati. Folia plana.

Hab. Austria-Hungary.

g. frigidus, *Kit.* (sp.) in *Flora,* 1824, p. 283; *auct. Pinks Cent. Eur.* p. 45.

Forma nana Hungarica.

h. orophilus, *Jord.* (sp.) *in Billot, Annot. Fl. de France,* p. 43.

25 centim. Folia incurva, radicalia 70 mm., caulina 38 mm. Flores geminati. Bracteæ 4 purpureo-marginatæ. Calyx purpureus, dentibus 9-nerviis.

i. consimilis, *Jord.* (sp.).

33 centim. Folia fere acicularia læte virentia, radicalia 72–85 mm., caulina 30 mm., vagina folii diam. duplo longiore. Flores 1–2 in caule. Calycis dentes 9-nervii.

Hab. Dauphiny.

k. saxicola, *Jord.* (sp.) *Pugill. Plant.*; *Willk. Ic. Descr. Pl. Nov. Hisp.* i. (1853), t. 12.

35 centim. Folia linearia acuminata canaliculata. Bracteæ 4 purpureo-marginatæ. Calyx purpureus, dentibus 9-nerviis.

Hab. Mt. Jura.

varr. prox. D. sylvestris, *Jacq.*—Caules biflori floribus subsessilibus v. furcati v. parce ramosi. Folia stricta subulato-acicularia.

l. forma *Jacq.*

36 centim. Caules parce ramosi. Folia radicalia 70 mm., caulina 36 mm., vagina pallida. Bracteæ 4–6. Calycis dentes purpurei 7-nervii.

Hab. Austria.

m. binatus, *Bartl.* (sp.) *in Wendl. Beitr. z. Botanik,* ii. p. 56; *Reichb. Fl. Germ. Exc.* p. 810; *Ic. Fl. Germ. Helv.* f. 5045.

20 centim. Flores subsessiles. Bracteæ 4. Calycis dentes 7-nervii. Lamina = $\frac{1}{3}$ unguis.

Hab. Croatia.

n. juratensis, *Jord.* (sp.) *in Billot, Annot. Fl. de France,* p. 47; *Gren. Fl. Ch. Jurass.* p. 105

Folia carinata. Flores speciosi. Bracteæ 4. Calycis dentes 7-nervii.

Hab. Mt. Jura.

o. Bauhinianus, *Noë* (sp.) *in Flora,* 1833, i. p. 143.

Forma nana Istriaca. Caules parce ramosi. Folia carinata. Bracteæ 4 margine pallidæ. Calycis dentes 9-nervii.

Geogr. limits.—*N.* Austria (Galicia), 50°.
S. Greece (Thessaly), 37°.
E. Turkey (Rumelia), 26°.
W. Spain (Catalonia), 1° E.

This is another of the species with a polymorphic tendency in which it is very difficult to circumscribe satisfactorily the limits of the specific type. One or more forms of the plant were certainly known to Pona (1595) and Caspar Bauhin, and it is also mentioned by John Ray as being found in Italy (1680). Pontedera and Seguier record its occurrence between Trent and Verona, on the confines of Venetia. It is probably the plant mentioned by Linnæus as an unscented variety of *D. Caryophyllus*, though it was not properly described and named as a species until 1786 by Wulfen.

165. D. LARICIFOLIUS, *Boiss. et Reut. Diagn. Pl. Nov. Hisp.* n. 9; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 688; *Willk. Ic. Descr. Pl. Nov. Hisp.* i. p. 12, t. 6.

Cæspitosus, glaucus. Caudex lignosus. Caules 37 centim., subsimplices teretes. Folia carinata fere acicularia; radicalia 15 mm. acuta falcata, caulina 20 mm. acuminata stricta adpressa, vagina folii diam. 3-plo longiore. Flores solitarii v. geminati, inodori. Bracteæ 4–6, exteriores lanceolatæ, interiores obovatæ atting. $\frac{1}{3}$ longit. calycis. Calyx apice attenuato, dentibus mucronatis. Petala non contigua; lamina rosea, $= \frac{1}{3}$ unguis. Antheræ lineari-oblongæ luteæ. Semina granulata.

Hab. Central Spain.

166. D. SERRATIFOLIUS, *Sibth. et Sm. Fl. Græca*, v. p. 2, t. 402; *Boiss. Fl. Orient.* i. p. 490.

25 centim. Caudex lignosus. Caules tenuiter virgati uniflori stricti. Folia 20 mm., subulata acuminata 3-nervia, radicalia patentia recurva, caulina stricta, vagina folii diam. duplo longiore. Bracteæ 4 oblongæ ad dimidium calycem. Calyx apice attenuato, dentibus acuminatis. Petala non contigua; lamina pallide rosea, subtus fuscescente oblongo-cuneata, $= \frac{1}{2}$ unguis. Antheræ luteæ. Capsula dentibus obtusis.

b. nazaræus, *Clark, Trav.* ii. p. 420; *Boiss. Fl. Orient.* i. p. 516. Caules stricte subramosi.

Geogr. limits.—*E.* Mt. Gargarus, in the Troad.
W. Mt. Hymettus, in N. Greece.

167. D. BALANSÆ, *Boiss. Fl. Orient.* i. p. 488.

Cæspitosus, basi suffrutescens, 15 centim. Caules humiles uni- vel rarius biflori. Folia linearia acuta stricta carinata 3-nervia, vagina folii diam. æquante, radicalia 25 mm., caulina 20 mm. Bracteæ 4 obovato-oblongæ ad dimidium calycem.

Calyx apice attenuato, dentibus acuminatis. Lamina obovato-cuneata rosea, = $\frac{1}{3}$ unguis.

Hab. Aslandach, in Cappadocia.

168. D. XYLORRHIZUS, *Boiss. et Heldr. Diagn. Pl. Nov. Or.* ser. I. viii. p. 67; *Boiss. Fl. Orient.* i. p. 486; *Raulin, Crit. Cretic.* t. 7.

Glaucus, 15 centim. Caules teretes uniflori. Folia 25 mm., 3-nervia lineari-lanceolata acuta plana incurva, vagina folii diam. æquante. Bracteæ 4 obovatæ, $\frac{1}{4}$ longit. calycis. Calyx superne subangustatus, dentibus acutis 9-nerviis scarioso-alatis. Petala contigua; lamina alba obovato-cuneata, = $\frac{1}{3}$ unguis.

Hab. Island of Crete.

** Bracteæ scariosæ. Calyx verruculosus.

169. D. PAPILLOSUS, *Vis. et Panč. in Mem. Ist. Venet.* x. (1861), p. 434; *Pl. Serbicæ Rariores*, dec. 1, p. 12, t. 5.

Caules 36 centim., ramosi tetragono-compressi. Folia 25 mm. linearia acuta patentia carinata, radicalia recurva, caulina stricta, vagina folii diam. æquante. Bracteæ 4 obovatæ ad $\frac{1}{4}$ calycis. Calyx dentibus acuminatis 7–9-nerviis. Lamina spathulata purpurea maculata, = $\frac{1}{2}$ unguis. Antheræ cæruleæ.

Geogr. limits.—*N.* Bosnia. *E.* Servia.
S. Montenegro. *W.* Herzegovina.

*** Bracteæ scarioso-alatæ. Calyx striatus.

170. D. ATTENUATUS, *Sm. in Trans. Linn. Soc.* ii. (1794), p. 301; *Gren. et Godr. Fl. de France*, i. p. 233; *Willk. Ic. Descr. Pl. Nov. Hisp.* i. p. 9, t. 3.

Cæspitosus, glaucus, basi suffrutescens. Caules 50 centim., diffusi tortuosi foliosi ramosi teretes. Folia plana linearia acuta pungentia 3-nervia, radicalia 18 mm. incurva, caulina 12 mm. adpressa, vagina folii diam. æquante. Flores solitarii aut gemini parvi, sæpe racemis cymosis aut paniculis laxis dispositi, inodori rosei. Bracteæ 6 oblanceolatæ ad dimidium calycem. Calyx apice attenuato, dentibus acuminatis scarioso-alatis 9-nerviis. Petala non contigua; lamina oblonga, = $\frac{1}{4}$ unguis. Antheræ ellipticæ flavicantes. Semina striolata.

Hab. Dept. of Pyrénées-Orientales in France; and Mt. Atlas in Morocco.

Smith's description was drawn up from specimens in the Paris Botanic Garden originally collected by Broussonet, "in maritimis Galliæ meridionalis." The plant referred to this species by Del Amo in his 'Flora fanerogamica de la Peninsula Iberica' (1873), vol. vi. p. 291, is the next species. It may possibly be the plant described by Tournefort as "Caryophyllus maritimus, supinus, foliis angustissimis aculeatis, multiflorus," or, as given in a few French floras, the still older "Caryophyllus sylvestris repens multiflorus" of C. Bauhin.

171. D. Sabuletorum, *Willk. Ic. Descr. Pl. Nov. Hisp.* i. p. 10, t. 4; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 683.

Parce cæspitosus. Caules 24 centim., teretes foliosi uniflori aut parce ramosi. Folia plana acuta 3-nervia, radicalia 9 mm. lineari-lanceolata incurva, caulina 12 mm. linearia stricta adpressa, vagina folii diam. æquante. Bracteæ 6–8 oblanceolatæ ad dimidium calycem. Calyx apice attenuato, dentibus acutis scarioso-alatis 9-nerviis. Petala non contigua; lamina obovata rosea, = ¼ unguis. Antheræ lineares flavicantes. Semina striolata.

Hab. South Aragon.

172. D. furcatus, *Balb. Obs. Œill. in Mém. Acad. Turin*, vii. (1802), p. 13, t. 2; *Prosp. Fl. Ligur.* p. 21; *Reichb. Icon. Fl. Germ. Helv.* 5046.

Cæspitosus, glaucus, gracilis, 17 centim. Caules furcati biflori tetragono-compressi. Folia flaccida patentia recurva acuminata 3-nervia, radicalia 20 mm. lineari-lanceolata, caulina 12 mm. linearia, vagina folii diam. æquante. Flores divergentes rosei inodori speciosi. Bracteæ 2 ad dimidium calycem, obovato-lanceolatæ. Calyx dentibus mucronatis scarioso-alatis 7-nerviis. Petala non contigua; lamina obovato-cuneata obtuse dentata margine reflexa, = ½ unguis. Antheræ oblongæ flavicantes. Capsula oblongo-elliptica, dentibus obtusis. Semina læviuscula.

Hab. Piedmont and Liguria, in Italy.

173. D. Nelsoni, *mihi, in Journ. of Botany*, 1889, p. 200.

Caules 46–52 centim., ramosi tetragono-compressi. Folia stricta adpressa; inferiora 38–40 mm., linearia acuta 9-nervia, superiora 21 mm., elongato-linearia acuminata canaliculata 7-nervia, vagina folii diam. æquante. Flores solitarii in cymis laxis dichotomis dispositi. Bracteæ 4 (interdum 6) calycem æquantes obovatæ infimis ovali-lanceolatis. Calyx purpureus,

dentibus acuminatis scarioso-alatis 9-nerviis. Petala non contigua alba; lamina obovata, = $\frac{1}{3}$ unguis. (Herb. Kew. *W. Nelson*, no. 554.)

Hab. Near Wonderfontein, in the Transvaal.

Among South-African species nearest to *D. crenatus*.

174. D. CACHEMIRICUS, *Edgew. in Hook. f. Fl. Brit. India*, i. p. 214.

Caules 48–52 centim., ramosi. Folia elongato-linearia acuminata canaliculata 3-nervia, vagina folii diam. æquante; radicalia 34 mm., reliqua 24 mm. Bracteæ 4 lanceolatæ ad bases dentium calycis. Calyx purpurascens, dentibus acuminatis 7-nerviis. Lamina obovata rosea, = $\frac{1}{2}$ unguis.

Hab. Cashmere.

175. D. LONGIGLUMIS, *Del. in Ann. Sci. Nat.* sér. II. xx. (1843), p. 89; *Walp. Repert.* v. p. 77; *A. Rich. Tent. Fl. Abyssin.* i. p. 42, t. 12.

Glaucus, 60 centim. Folia lineari-lanceolata acuminata plana, vagina caulis diam. æquante, radicalia 136 mm. 9-nervia, caulina 42 mm. 7-nervia. Caules uniflori. Bracteæ 4 lanceolatæ ad dimidium calycem. Calyx 55 mm., dentibus acuminatis scarioso-alatis 7-nerviis. Petala contigua, lamina obovato-cuneata.

Hab. Abyssinia.

176. D. JACQUEMONTII, *Edgew. in Hook. f. Fl. Brit. India*, i. p. 214.

Cæspitosus. Caudex lignescens. Caules 20 centim. uniflori, tetragono-compressi. Folia linearia acuta plana uninervia; radicalia 30 mm. recurva, caulinia 22 mm. incurva, vagina folii diam. duplo longiore. Flores odorati. Bracteæ 4 obovatæ ad $\frac{1}{4}$ calycis. Calyx dentibus acuminatis scarioso-alatis 7-nerviis. Petala contigua, lamina obovato-cuneata rosea.

Hab. Cashmere.

b. minor, *mihi.*

10 centim. Folia 12 mm. Lamina oblongo-cuneata alba.

Hab. Shapiyon, in Cashmere. (Herb. Kew. *C. B. Clarke*, no. 28603).

177. D. PACHYPETALUS, *Stapf, Bot. Polak. Exped. Pers.* p. 11.

Caules 25 centim., ramosi. Folia basilaria 20–40 mm. 3-5-nervia, lineari-subulata carinata, nervis lateralibus tenuibus, cetera 15 mm. 3-nervia subulata v. setacea, vagina folii diam.

æquante. Bracteæ 6 (rarius 4) oblongæ ad dimidium calycem. Calyx dentibus acutis zonatis ciliolatis. Lamina crassa obovato-cuneata luteo-virens.

Hab. Persia.

Sectio iv. IMPARJUGUM.

Bracteæ nunquam 4. Petala dentata v. integra, imberbia. Capsula cylindrica.

Subsectio 1. *Platylepides.*

Bracteæ latæ mucronatæ.

* Bracteæ scariosæ. Calyx verruculosus.

178. D. SULCATUS, *Boiss. Fl. Orient.* i. p. 483; *Boiss. in Tchihatch. Asie Min. bot.* i. p. 222 (D. quadrilobus).

Glaber. Caules 26 centim., numerosi tenues erecti v. diffusi flexuosi dichotome ramosi teretes. Folia 30 mm., linearia acuminata carinata flaccida, vagina folii diam. æquante. Flores corymbose dispositi. Bracteæ 2 ovatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx dentibus oblongis muticis 7–9-nerviis. Petala contigua, lamina parva dentata pallide rosea lineis saturatioribus sulcata.

Hab. Kurdistan and Turkish Armenia.

** Bracteæ scarioso-alatæ. Calyx striatus.

179. D. SYRIACUS, *mihi, in Journ of Botany,* 1885, p. 346; *Enum. spp. varr. Dianthus,* p. 19.

Glaber, 20 centim. Caules ramosi teretes. Folia linearia patentia 3-nervia, radicalia 24 mm. obtusa carinata, caulina 8 mm. acuta plana, vagina caulis diam. æquante. Flores paniculis laxis dispositi. Bracteæ 2 obovatæ, ad dimidium calycem patentes. Calyx apice attenuato, dentibus scarioso-alatis lanceolatis acuminatis purpureis 9-nerviis. Lamina oblonga. (Herb. Mus. Brit. *Aucher-Eloy,* no. 501.)

Hab. N. Syria.

180. D. GASPARINII, *Guss. Fl. Sic. Syn.* i. p. 497; *Arcang. Compend. Fl. Ital.* p. 86.

Glaber, 25 centim. Caules tenues tetragoni uniflori. Folia elongato-linearia acuminata carinata stricta adpressa, 30 mm., vagina folii diam. æquante. Bracteæ 6–8 obovato-lanceolatæ ad-

pressæ ad $\frac{1}{4}$ calycis. Calyx apice attenuato, dentibus lanceolatis acuminatis 7-nerviis. Petala non contigua; lamina oblongo-cuneata purpurea, = $\frac{1}{2}$ unguis.

Geogr. limits.—Sicily.

181. D. CILIATUS, *Guss. Ind. Sem. Boccadif.* (1825), p. 5, et *Pl. Rar.* (1826), p. 168; *Tanfani, in Parl. Fl. Italiana*, ix. p. 289; *Reichb. Icon. Fl. Germ. Helv.* f. 5047.

Cæspitosus, glaber, glaucus. Caules 60 centim., simplices 4-angulares vel superne paniculatim aut cymoso-ramosi. Folia 20 mm., anguste linearia canaliculata, radicalia patentia recurva aciculata, caulina acuta adpressa, vagina folii diam. duplo longiore. Flores geminati pedunculis longis, odorati. Bracteæ 6–8 obovatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx apice attenuato dentibus lanceolatis acuminatis ciliolatis. Petala non contigua; lamina dentata v. integra rosea oblonga, = $\frac{1}{2}$ unguis. Antheræ lineari-ellipticæ purpureæ. Semina granulata.

b. racemosus, *Vis.* (sp.) *in Flora* (1829), *Erg.* p. 12; *Fl. Dalmat.* iii. p. 162; *Reichb. Ic. Fl. Germ. Helv.* 5047.

Caules paniculatim ramosi, floribus laxe racemosis.

c. cymosus, *Vis. Fl. Dalmat.* iii. p. 162; *Host, Fl. Austriaca*, i. p. 522 (D. litoralis); *Beck et Szyszyl. Pl. Cernag.* p. 65 (1888), t. 3 (= D. medunensis).

Caules cymoso-ramosi floribus laxe cymosis. Lamina obovata vix dentata.

d. serrulatus, *Brocchi* (sp.) *Giorn. in Egitto*, i. p. 21; *Vis. Fl. Dalmat.* iii. p. 162 (D. ciliatus, *var.* Brocchianus).

Folia obtusiuscula patentia. Bracteæ 8. Lamina obovata.

Geogr. limits.—*N.* Istria, in Austria, 46°.
S. Lower Egypt, 28°.
E. Lower Egypt, 32°.
W. Campania, in Italy, 13°.

182. D. ARAGONENSIS, *Timb. in Mém. Acad. Toul.* sér. VI. vol. v. (1867), p. 236; *Monogr. Dianth. Pyr. Fr.* p. 16, t. 19.

Cæspitosus, glaber. Caules 15 centim., simplices teretes biflori valde geniculati. Folia 25 mm., 3–5-nervia anguste linearia stricta patentia plana, vagina folii diam. æquante. Bracteæ 6–8, inferiores ovali-lanceolatæ, superiores obovatæ, patentes ad dimidium calycem. Calyx dentibus lanceolatis acuminatis. Petala non

contigua; lamina dentata subrhomboidea lilacina, = $\frac{1}{2}$ unguis. Semina granulata.

Hab. North Aragon.

183. D. MULTICEPS, *Costa, Fl. Catal.* (1864), p. 35; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 682.

Cæspitosus, asperulus. Caules 20 centim., simplices v. apice ramosi stricti teretes. Folia lineari-lanceolata acuta stricta plana 3–5-nervia, radicalia 40 mm. recurva, caulina breviora adpressa, vagina folii diam. æquante. Bracteæ 6 ovales subpungentes patentes ad $\frac{1}{3}$ calycis. Calyx apice attenuato, dentibus lanceolatis mucronatis. Petala non contigua; lamina dentata parva rosea spathulato-cuneata. Semina striolata.

b. decalepis, *mihi*, = D. ciliatus, *Costa, Fl. Catal.* p. 36 (non *Guss.*); *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 683 (D. Costæ).

Bracteæ 10.

Hab. Catalonia.

184. D. LEGIONENSIS, *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 684; *Pug. Plant. Hisp.* (1860–65), p. 301 (uti D. attenuatus *var.*).

Glaber. Caules 30 centim., furcati teretes. Folia acuta canaliculata; radicalia 19 mm. elongato-linearia, infer. caulina 16 mm. lineari-lanceolata patentia, reliqua 10 mm. linearia stricta adpressa, vagina folii diam. æquante. Flores parvi longe pedunculati rosei. Bracteæ 6 obovatæ patentes ad $\frac{1}{3}$ calycis. Calyx apice attenuato, dentibus lanceolatis acutis. Petala non contigua; lamina integra obovato-cuneata, = $\frac{1}{3}$ unguis. Antheræ violaceæ.

Geogr. limits.—*N.* Mountains of Asturias.
S. Mountains of Castile.
E. R. Pisuerga.
W. Portuguese frontier.

185. D. VIRGINEUS, *Gren. et Godr. Fl. de France*, i. p. 238; *Godr. in Mém. Soc. Nat. Nancy*, 1846 (Obs. sur le D. virgineus); *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 688.

Cæspitosus, glaucus, glaber. Caules 20 centim., simplices v. superne parce ramosi graciles angulati. Folia triquetro-subulata acuminata contorta, vagina folii diam. æquante, radicalia 14 mm. patentia, caulina 8 mm. adpressa, summis bracteiformibus. Flores solitarii odorati. Bracteæ 6, inferiores oblanceolatæ, superiores obovatæ, adpressæ ad $\frac{1}{4}$ calycis. Calyx apice attenuato,

dentibus lanceolatis acuminatis scarioso-alatis. Petala non contigua; lamina dentata oblongo-cuneata rosea, = ½ unguis. Antheræ oblongæ violaceæ. Semina granulata.

b. mauritanicus, *Ball.* Folia multum contorta.

Geogr. limits.—*N.* Dept. of Drôme, 45°.
S. Tetuan in Morocco, 34°.
E. Southern Italy, 17°.
W. Mt. Atlas, in Morocco, 6°.

The Linnean species described under this name cannot be identified, and therefore is not maintained: Jacquin's plant = *D. sylvestris.*

Subsectio 2. *Stenolepides.*

Bracteæ angustæ acuminatæ.

* Bracteæ 2, scariosæ.

186. D. REPENS, *Willd. Sp. Plantarum*, ii. p. 681; *Ledeb. Fl. Rossica*, i. p. 281; *Seem. Bot. Voy. Herald*, t. 4.

Cæspitosus. Caules 20 centim., teretes uniflori filiformes flexuosi numerosi. Folia linearia obtusa plana flaccida, vagina folii diam. æquante, radicalia 27 mm., cetera 22 mm. Bracteæ ovatæ calycem superantes. Calyx dentibus ovatis obtusis 9–11-nerviis. Petala dentata non contigua; lamina obovato-cuneata rosea, = unguem. Antheræ elliptico-lineares.

Geogr. limits.—*S.* and *E.* Between Irkutsk and Okhotsk, in Siberia, long. 140°.
N. and *W.* West Coast of Greenland, long. 50°.

** Bracteæ 6–10, scarioso-alatæ.

187. D. SICULUS, *J. et C. Presl, Del. Prag.* p. 59; *Guss. Fl. Sic. Syn.* i. p. 479; *Tanfani, in Parl. Fl. Italiana*, ix. p. 284.

Caules 40 centim., ramosi teretes. Folia linearia obtusa recurva carinata, vagina folii diam. duplo longiore, radicalia 90 mm., caulina 70 mm. 3-nervia. Flores solitarii odorati. Bracteæ 6–8 coriaceæ, elliptico-lanceolatæ patentes ad ⅓ calycis. Calyx coriaceus apice attenuato, dentibus acutis 7-nerviis. Petala non contigua; lamina purpurea oblongo-cuneata dentata, = ½ unguis. Antheræ oblongæ rubescentes. Semina granulata.

b. miniatus, *Huet, Exsicc.* 1855, *ex Nym. Consp. Fl. Eur.* p. 105.

Caules simplices. Folia elongato-linearia acutiuscula. Lamina obovato-cuneata rosea.

This variety of the species is described from specimens in *Herb. Mus. Brit.*

Geogr. limits.—*N.* Near Bastia, in Corsica, 43° N.
S. Tunis.
E. Elladha, Mt. Pindus, in Thessaly, 21°.
W. Morocco.

188. D. KREMERI, *Boiss. et Reut. Pug. Plant.* p. 21; *Munby, Cat. Pl. Alger.* p. 5.

Glaber. Caules 27 centim., teretes ramosi. Folia elongato-linearia acuminata incurva, vagina folii diam. æquante. Bracteæ 8–10 lanceolato-oblongæ ad $\frac{1}{3}$ calycis. Calyx dentibus lanceolatis acuminatis rubellis. Lamina integra cuneato-spathulata rosea.

Hab. Algeria.

189. D. STENOCEPHALUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 19; *Fl. Orient.* i. p. 491.

Scaber, basi suffrutescens. Caules 60 centim., simplices teretes foliosi. Folia 55 mm., anguste linearia acuminata plana stricta adpressa 3–5-nervia, vagina folii diam. 4-plo longiore. Bracteæ 8 ovatæ calycem æquantes. Calyx stramineus, dentibus lanceolatis acuminatis 11-nerviis. Petala contigua; lamina parva obovata obtuse dentata, supra alba, subtus flavicante, = $\frac{1}{4}$ unguis.

b. glaber, *mihi*, = D. talyschensis, *Boiss. et Buhse, Reise Transc. Persien*, p. 34; *Boiss. Fl. Orient.* i. p. 491.

Glaber, 28 centim. Vagina folii diam. duplo longiore. Bracteæ elliptico-lanceolatæ. Calyx apice subangustatus. Lamina obovato-cuneata.

190. D. FRAGRANS, *Bieb. Fl. Taur.-Cauc.* i. pp. 331, 428, iii. p. 301; *Cent. Pl. Rar.* i. t. 23; *Boiss. Fl. Orient.* i. p. 491; *Sims, Bot. Mag.* t. 2067.

Cæspitosus, glaber. Caules 40 centim., simplices v. superne parce ramosi tetragono-compressi numerosi. Folia elongato-linearia acuminata 3–5-nervia, vagina folii diam. æquante, radicalia 27 mm. recurva, caulina stricta. Flores odorati. Bracteæ 6–8 obovato-oblongæ adpressæ ad dimidium calycem. Calyx dentibus lanceolatis acuminatis pungentibus 9-nerviis.

Petala non contigua ; lamina integra alba roseo-suffusa maculata, margine recurva obovato-cuneata, = $\frac{1}{4}$ unguis. Antheræ albidæ.

b. macrocolpus, *mihi.*

Caules uniflori, 30 centim. Vagina folii diam. 3-plo longiore. Calyx apice attenuato, dentibus ciliolatis. Lamina dentata.—*Herb. Kew.* "Batterie Espagnole," Oran, in Algeria.

This plant, in the Kew Herbarium, is labelled *D. Kremeri*, with a note added, "sed petalis dentatis." It certainly does not agree with the description of this species, but differs from it in many points. I have failed to match it with any other Algerian species, though it does seem to be very similar to *D. fragrans* of the Caucasus. The characters of the plant are not emphasized sufficiently so as to make it appear to be specifically distinct from others of the same group with which it is evidently allied; and I therefore prefer to consider it as a variety. The name is derived from the length of the leaf-sheath as compared with that in the specific type.

Geogr. limits.—*N.* Near Nartzana, in Ciscaucasia.
E. Near Elisabethpol, in Transcaucasia.
S. *W.* } Near Oran, in Algeria.

191. D. HOLOPETALUS, *Turcz. in Bull. Soc. Nat. Mosc.* xxvii. pt. 2 (1854), p. 369; *Harv. et Sond. Fl. Capensis*, i. p. 214.

Glaber vel pubescens, 40 centim. Caules uniflori, inferne 4-angulares, superne teretes. Folia radicalia 55 mm. elongato-linearia acuminata, caulina 34 mm. lineari-lanceolata acuta, vagina folii diam. æquante. Bracteæ 6–8, ovato-lanceolatæ patentes ad dimidium calycem. Calyx dentibus lanceolatis acuminatis. Petala contigua, lamina dentata v. integra oblonga rosea.

Hab. Cape Colony.

This species also includes *D. pectinatus*, which is not specifically distinct.

192. D. ANGOLENSIS, *Hiern*; *auct. in Journ. of Botany*, 1886, p. 301; *Enum. spp. varr. Dianthus*, p. 19.

Glaber, basi suffrutescens, 30 centim. Caules ramosi teretes tenues foliosi. Folia lanceolato-linearia adpressa; radicalia 5-nervia, caulina 3-nervia, vagina folii diam. æquante. Flores racemis laxis nec sæpius subsolitarii. Bracteæ 6–8, ovatæ

adpressæ ad dimidium calycem. Calyx dentibus lanceolatis acutis. Petala contigua, lamina dentata obovata.

Hab. Near Caconda, in Angola, Tropical Africa, 14° S.

Mr. W. P. Hiern, the able monographer of the Ebenaceæ, kindly sent me the description of this plant, which is an interesting addition to the species which occur within the tropical zone: the others being *D. longiglumis* and *D. leptoloma* in Abyssinia, and *D. superbus* in South China.—Calyx 16–18 mm. long, 3 mm. diam., teeth 6 mm. long; lamina of petals 9 mm. long, 5 mm. broad, teeth of lamina 1·25 to 1·43 mm. long.

Sectio V. Tetralepides leiopetala.

Bracteæ semper 4. Petala integra v. dentata, imberbia. Capsula cylindrica.

Subsectio 1. *Hispanioides.*

Caules ramosi. Folia caulina adpressa, vagina folii diam. æquante. Bracteæ atting. $\frac{1}{3}$ calycis tubum.

* Petala non contigua.

193. D. hispanicus, *Asso, Syn. Stirp. Arag.* p. 53; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 690; *Willk. Ic. et Descr. Pl. Nov. Rar. Hisp.* i. p. 16, t. 9.

Glaber aut scaber, glaucus, basi suffrutescens. Caules 25 centim., dichotome ramosi, inferne tetragoni, superne teretes. Folia 20 mm. 3-nervia, plana, radicalia linearia acuminata patentia, reliqua anguste linearia acuta, vagina pallida. Bracteæ mucronatæ adpressæ late scariosæ, inferiores ovales, superiores obovato-oblongæ. Calyx purpurascens apice attenuato, dentibus ovatis obtusis purpureis 7–9-nervis. Lamina obovato-cuneata rosea, $=\frac{1}{2}$ unguis. Antheræ lineari-ellipticæ violaceæ. Semina læviuscula.

a. borealis, *Willk. Ic. et Descr. Pl. Nov. Rar. Hisp.* i. p. 16, t. 9 B; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 690.

Caules fere simplices. Lamina integra.

b. australis, *Willk. Ic. et Descr. Pl. Nov. Rar. Hisp.* i. p. 16, t. 9 B; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 690.

Caules graciliores sæpius pluriflori. Flores minus speciosi. Lamina obtuse dentata.

Geogr. limits.—*N.* Near Tudela, in Navarre.
E. Monsant, in South Catalonia.
S. Sierra Nevada, 950 metres.
W. Mt. Torozo, near Valladolid.

This species was first recorded in Aragon by Asso in 1779.

194. D. HIRTUS, *Vill. Hist. Pl. Dauph.* iii. p. 593, t. 46; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 681; *Reichb. Ic. Fl. Germ. Helv.* f. 5043.

Laxe cæspitosus, scaber, habitu gracilis, 16 centim. Caules teretes. Folia anguste linearia stricta acuminata 3-nervia; radicalia 37 mm. plana patentia, caulina 25 mm. carinata. Flores solitarii v. geminati. Bracteæ acuminatæ late scariosæ, exteriores lanceolatæ patentes, interiores lanceolato-ovatæ subpatulæ. Calyx dentibus lanceolatis cuspidatis scarioso-alatis 9-nerviis. Lamina dentata obovato-cuneata purpurea, = unguem. Antheræ oblongæ. Semina granulata.

Geogr. limits.—*N.* and *E.* Colmar, in Germany.
S. and *W.* Viladran, in the Spanish Pyrenees.

b. parviflorus, *Benth. Cat. Pl. Pyren.* p. 75; *auct. Pinks West. Eur.* p. 38.

Glaber. Lamina = $\frac{1}{2}$ unguis.

Hab. Republic of Andorra.

195. D. REQUIENII, *Gren. et Godr. Fl. de France,* i. p. 234; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 682; *Timb. Monogr. Dianth. Pyr. Fr.* p. 14, t. 12.

Cæspitosus, glaber, glaucus, habitu gracilis, 35 centim. Caules bifurcati 4-angulares. Folia linearia stricta acuta plana 3-nervia. Bracteæ acuminatæ late scariosæ, exteriores lanceolatæ patentes, interiores ovali-lanceolatæ subpatulæ. Calyx apice attenuato, dentibus lanceolatis cuspidatis scarioso-alatis 9-nerviis. Lamina dentata subrhomboidea purpurea, = $\frac{1}{3}$ unguis. Antheræ ellipticæ. Semina granulata.

Hab. Pyrenees.

196. D. ALBENS, *E. Mey. ex Harv. et Sond. Fl. Capensis,* i. p. 123.

Glaber, 25 centim. Folia linearia acuta carinata; radicalia 40 mm., reliqua 25 mm. Bracteæ obovatæ mucronatæ adpressæ. Calyx dentibus ovatis acutis. Lamina rosea v. alba integra obovata, = $\frac{1}{2}$ unguis. Semina granulata.

Hab. South Africa.

D. hispanicus differs from this species chiefly in the glaucous leaves and smooth seeds.

** Calyx verruculosus. Petala contigua.

197. D. TRIPUNCTATUS, *Sibth. et Sm. Fl. Græca*, iv. p. 86, t. 398; *Tanfani, in Parl. Fl. Italiana*, ix. p. 275.

Glaber. Caules 37 centim., teretes ramis patulis. Folia radicalia 35 mm. linearia acuta patentia plana 5-nervia, reliqua 25 mm. elongato-linearia acuminata canaliculata 3-nervia, vaginis pallidis. Bracteæ late membranaceæ acuminato-cuspidatæ, exteriores ovato-lanceolatæ, interiores ovatæ. Calyx apice attenuato, dentibus lanceolatis acuminatis purpureis scarioso-marginatis 9–11-nerviis. Lamina dentata oblongo-cuneata rosea basi saturatius trilineata, = unguem. Antheræ cærulescentes. Semina granulata.

b. Barati, *Duv.* (sp.) *in Bull. Soc. Bot. France*, 1855, p. 351; *auct. Enum. spp. varr. Dianth.* p. 19.

Geogr. limits.—*N.* Trezene, in the Morea.
S. and *W.* Algeria.
E. Cyprus.

Subsectio 2. *Sætabenses.*

Caules ramosi. Folii vagina diam. ejusdem æquante. Bracteæ atting. $\frac{1}{2}$–$\frac{2}{3}$ calycis tubum.

* Bracteæ mucronatæ adpressæ.

198. D. KAMISBERGENSIS, *Sond. in Harv. et Sond. Fl. Capensis*, i. p. 124; *Walp. Ann.* vii. p. 262.

Glaber. Caules 37 centim., paniculati teretes. Folia stricta; radicalia 40 mm. linearia acuta, caulina angustius linearia acuminata. Bracteæ obovatæ scarioso-alatæ. Petala integra v. dentata contigua, lamina obovato-cuneata rosea.

Hab. Kamisberge, Cape Colony.

199. D. ANDERSONII, *mihi, in Journ. of Botany*, 1885, p. 346 (char. emend.).

Pubescens. Caules 15–27 centim., furcati teretes. Folia 10 mm. 5-nervia, linearia acuta adpressa, vaginis pallidis. Flores parvi. Bracteæ obovatæ scariosæ. Calyx dentibus lanceolatis

acuminatis purpureis scarioso-alatis 9-nerviis Lamina obovato-cuneata rosea, = unguem.—(Kotschy, it. 1855, *Herb. Mus. Brit.*).

Hab. Syria.

200. D. SÆTABENSIS, *Rouy, in Bull. Soc. Bot. France*, 1882, p. 44; *auct. Pinks West. Eur.* p. 39.

Cæspitosus. Caules 40 centim., dichotome ramosi teretes. Folia linearia plana 3-nervia flaccida; radicalia obtusa, caulina acuta, vaginis pallidis. Bracteæ ovali-lanceolatæ late scariosæ. Calyx apice attenuato, dentibus lanceolatis acuminatis. Lamina obovato-cuneata rosea, = $\frac{1}{2}$ unguis. Semina læviuscula.

b. minor, *Rouy*.

c. media, *Rouy*.

Hab. Prov. Valencia, in Spain.

There are good specimens of this plant in Herb. Mus. Brit., from which, with the assistance of the original description, this species has been described and its position in the genus determined. Though very similar in habit to *D. hispanicus*, it appears to be sufficiently distinct from the other species of the east of Spain.

** Bracteæ acuminatæ patentes.

201. D. PLANELLÆ, *Willk. Ic. et Descr. Pl. Nov. Rar. Hisp.* i. p. 79, t. 53; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 681.

Cæspitosus, glaber, glaucus. Caudex crassus. Caules 44 centim., tenues teretes divaricati internodiis longis. Folia elongato-linearia acuminata 3-nervia plana, radicalia 72 mm. falcata, caulina 50 mm. Flores solitarii v. geminati parvi rosei cymis laxis. Bracteæ ovales scarioso-alatæ. Calyx apice attenuato, dentibus lanceolatis acuminatis. Petala non contigua, lamina oblongo-cuneata truncata dentata. Antheræ luteæ.

Hab. North and south of R. Minho, in Spain and Portugal.

202. D. AURANITICUS, *Post, in Journ. Linn. Soc.* xxiv. (1888), p. 422; *auct. Enum. spp. varr. Dianthus*, p. 20.

Glaber, glaucus, 30 centim. Caules parce ramosi angulariter compressi. Folia 40–45 mm., linearia acuta canaliculata. Bracteæ oblongo-lanceolatæ scarioso-alatæ. Calyx dentibus triangularibus mucronatis. Lamina obovato-spathulata dentata.

Hab. Between Irbid and Bozrah in the plain of Haurân, Palestine.

Subsectio 3. *Cintrani.*

Caules simplices. Bracteæ mucronatæ.

* Caules teretes. Bracteæ scarioso-marginatæ.

203. D. ELONGATUS, *C. A. Mey. Verz. Pfl. Cauc.* p. 211; *Boiss. Fl. Orient.* i. p. 484.

Glaber. Caules 35 centim., uniflori. Folia linearia acuminata patentia plana 3-nervia, vagina folii diam. æquante. Flores odorati. Bracteæ obovatæ ad $\frac{1}{4}$ calycis. Calyx dentibus lanceolatis acutis ciliolatis. Petala non contigua; lamina oblonga dentata rosea v. alba concolori, $= \frac{1}{3}$ unguis.

Hab. W. Caucasus.

204. D. MICRANTHUS, *Boiss. et Heldr. Diagn. Pl. Nov. Or.* ser. I. viii. p. 69; *Boiss. Fl. Orient.* i. p. 488.

Cæspitosus, basi suffrutescens, glaber. Caules 25 centim., tenues stricti 1–2-flori. Folia 20 mm., anguste linearia acuminata carinata adpressa 3-nervia, vagina folii diam. duplo longiore. Bracteæ exteriores ovales, interiores obovatæ, adpressæ ad $\frac{1}{3}$ calycis. Calyx dentibus ovatis obtusis anguste membranaceis ciliolatis. Petala integra; lamina obovato-oblonga, supra albida, subtus rubella, $= \frac{1}{3}$ unguis.

b. minor, *Boiss.*

Hab. Karamania, in Asia Minor.

205. D. HAUSSKNECHTII, *Boiss. Fl. Orient.* i. p. 489.

Cæspitosus, glaber. Caules 15 centim., tenues sæpissime uniflori. Folia anguste linearia acuminata carinata; radicalia 7-nervia patentia, caulina 5-nervia adpressa, vagina folii diam. duplo longiore. Bracteæ exteriores ovales, interiores obovatæ, adpressæ ad $\frac{1}{3}$ calycis. Calyx dentibus triangularibus acutis anguste membranaceis. Petala dentata; lamina obovata, supra albida, subtus rubella, $= \frac{1}{3}$ unguis.

Hab. Masmeneu-Dagh and Beryt-Dagh, in Cappadocia.

206. D. CINTRANUS, *Boiss. et Reut. Pug. Plant.* p. 20; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 681; *Willk. Ic. et Descr. Pl. Nov. Hisp.* i. p. 18, t. 10.

Glaber. Caudiculi longi prostrati. Caules 25 centim. Folia 48 mm. linearia acuta flaccida 3-nervia plana, vagina caulis diam. æquante. Flores geminati. Bracteæ exteriores oblongo-ovatæ,

interiores oblongæ, adpressæ ad dimidium calycem. Calyx apice attenuato, dentibus lanceolatis acutis scarioso-marginatis. Petala non contigua; lamina dentata oblongo-spathulata rosea, = $\frac{1}{3}$ unguis. Antheræ lineari-oblongæ luteæ.

Geogr. limits.—*N.* R. Vouga, 40° 40′.
S. Estuary of the Tagus, 38° 20′.
E. Sierra de Gredos, 5° 30′ W.
W. Estuary of the Tagus, 9° 40′.

207. D. ALGETAMUS, *Graells*; *auct. Enum. spp. varr. Dianthus*, p. 21; *Pinks West. Eur.* p. 41.

Cæspitosus, glaucus, glaber, 22 centim. Folia 9 mm. 3-nervia, linearia acuta carinata adpressa, summis minimis, vagina folii diam. æquante. Flores geminati rosea. Bracteæ ovato-lanceolatæ patentes ad $\frac{1}{3}$ calycis. Calyx purpureus apice attenuato, dentibus lanceolatis acuminatis. Lamina dentata obovata.—(*Herb. Mus. Brit.* Hispania.)

I can find no published description of this plant, nor am I acquainted with any other new pinks described by Graells; so that this species has been described from the Museum specimens, which were gathered at Algete near Madrid.

208. D. LANGEANUS, *Willk. Ic. et Descr. Pl. Nov. Hisp.* p. 78, t. 52 (D. hispanicus, *var.* occidentalis); *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 690; *auct. Pinks West. Eur.* p. 42.

Laxe cæspitosus, glaucus, glaber, 20 centim. Folia 13 mm. 3-nervia, linearia mucronata patentia stricta canaliculata, vaginis rubellis. Flores parvi. Bracteæ obovatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx purpureus apice attenuato, dentibus lanceolatis obtusis 7-nerviis. Petala non contigua; lamina integra obovato-cuneata rosea truncata. Antheræ luteæ.

Hab. N.W. Spain.

** Caules 4-angulares. Bracteæ scarioso-marginatæ.

209. D. STRICTUS, *Sibth. et Sm. Fl. Græca*, v. p. 2, t. 403; *Boiss. Fl. Orient.* i. p. 486; *Reichb. Ic. Fl. Germ. Helv.* f. 5041 b (D. bebius).

Cæspitosus, glaber. Caules 22 centim., stricti uniflori gracillimi, interdum biflori. Folia lineari-lanceolata stricta acuta patentia plana, radicalia 30 mm. 5-nervia, caulina 24 mm. 3-nervia, vagina folii diam. æquante. Flores inodori parvi albi pedunculis

prælongis. Bracteæ obovatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx apice attenuato, dentibus lanceolatis acuminatis scarioso-marginatis. Petala non contigua; lamina ovali-rhomboidea, $=\frac{1}{4}$ unguis. Antheræ ellipticæ albidæ. Semina lævia.

b. grandiflorus, *Vis. Fl. Dalmat.* iii. p. 163, t. 36; *auct. Pinks Cent. Eur.* p. 49.

Folia lineari-lanceolata. Flores magni. Calyx viridis, 25 mm. Lamina dentata.

c. bebius, *Vis.* (sp.) *Fl. Dalmat.* iii. p. 163; *auct. Pinks Cent. Eur.* p. 49.

Folia linearia. Flores speciosi. Calyx purpureus. Lamina dentata.

d. integripetalus, *Schur* (sp.), *Enum. Pl. Transsilvaniæ*, p. 98; *auct. Pinks West. Eur.* p. 49.

Folia lineari-lanceolata. Flores parvi. Calyx purpureo-viridis, 25 mm. Lamina integra.

e. biflorus, *mihi*, *Pinks West. Eur.* p. 49.

Caules biflori. Folia linearia. Calyx viridis, 20 mm. Lamina crenata. (*Herb. Mus. Brit.*)

f. condensatus, *Kit.* (sp.) *in Linnæa*, 1863, p. 532; *Borb. Symb. Caryoph. Fl. Croat.* p. 9.

Folia linearia. Bracteæ $\frac{1}{2}$ calycis tubum æquantes. Calycis dentes purpurei. Lamina dentata obovato-cuneata.

g. integer, *Vis.* (sp.) *in Flora*, 1829, i. Erg. p. 11; *Fl. Dalmat.* iii. p. 163; *Reichb. Ic. Fl. Germ. Helv.* f. 5042.

Caules fere repentes. Folia lineari-lanceolata. Flores parvi. Bracteæ $\frac{1}{2}$ calycis tubum æquantes. Calyx purpureo-viridis, 12 mm. Lamina integerrima obovato-cuneata.

Geogr. limits.—*N.* Karlstadt district in Croatia, 45°.
S. In the mountainous district between Corinth and Patras, in the Morea, 38°.
E. Mt. Athos, in Rumelia, 24°.
W. On calcareous hills, coast of Dalmatia, 15°.

210. D. BRACHYANTHUS, *Boiss. Voy. Bot. Espagne*, p. 85, t. 24; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 689; *Willk. Icon. Descr. Pl. Nov. Hisp.* i. p. 11, t. 5.

Cæspitosus, glaucus, glaber. Rhizoma crassum perpendiculare multiceps interdum prælongum. Caules 25 centim., tenues graciles. Folia linearia stricta plana 3-nervia; radicalia 12 mm.,

acuta patentia, caulina 8 mm., obtusa adpressa, vagina folii diam. æquante. Flores solitarii parvi. Bracteæ orbiculares patentes ad $\frac{1}{3}$ calycis. Calyx purpureus apice attenuato, dentibus ovatis acutis scarioso-marginatis. Petala contigua integra; lamina obovata rosea, subtus pallidiore, = $\frac{1}{2}$ unguis. Antheræ lineares. Semina læviuscula.

b. montanus, *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 689; *Willk. Icon. Descr. Pl. Nov. Hisp.* p. 11, t. 5 b.

Caules elongati apice sæpe furcati; turionibus propter stationem sæpius surculis transmutatis. Flores in unguibus atque stylis dimorphici. Calyx 11–14 mm. Petala vix contigua.

c. humilis, *Nym. Consp. Fl. Europ.* p. 106; *auct. Pinks West. Eur.* p. 42.

Densius cæspitosus, caulibus abbreviatis paucis.

d. macranthus, *Gren. et Godr. Fl. de France*, i. p. 235; *auct. Pinks West. Eur.* p. 42.

Calyx duplo major. Lamina denticulata v. integra varians, = unguem.

e. alpinus, *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 689; *Costa, Fl. Catal. Suppl.* p. 12 (D. brachyanthus, *var.* tarraconensis).

Minor, dense cæspitosus, læte virens, vix glaucus. Caules 8 mm. interdum apice furcati, turionibus estipitatis dense congestis. Calyx 6–7 mm. Petala non contigua, lamina = $\frac{1}{3}$ unguis.

Geogr. limits.—*N.* Dept. of Aude, 41°.
S. Sierra Nevada, 37°.
E. Eastern Pyrenees, 3° E.
W. Prov. of Asturias, 6° W.

211. D. INSIGNITUS, *Timb. in Mém. Acad. Toul.* sér. VI. vol. v. p. 236; *Bull. Soc. Bot. France*, xi. (1864), p. 143; *Monogr. Dianth. Pyr.* p. 17, t. 20.

Glaber. Caules 15 centim., uniflori tenues. Folia 20 mm. 3-nervia, linearia acuta plana stricta, vagina folii diam. æquante. Bracteæ ovali-lanceolatæ patentes ad $\frac{1}{3}$ calycis. Calyx dentibus scariosis lanceolatis ciliolatis mucronatis. Petala integra contigua; lamina orbiculari rosea, = $\frac{1}{3}$ unguis. Antheræ ovales violaceæ. Capsula dentibus obtusis. Semina læviuscula.

Hab. Pyrenees.

*** Bracteæ stramineæ.

212. D. COGNOBILIS, *Timb. in Bull. Soc. Bot. France*, xi. (1864), p. 143; *Mém. Acad. Toul.* sér. VI. vol. v. p. 241; *Monogr. Dianth. Pyr.* p. 14, t. 13.

Cæspitosus, glaber, basi suffrutescens. Caules 15 centim., biflori tenues. Folia linearia acuta carinata adpressa. Bracteæ obovato-lanceolatæ mucronatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx coriaceus apice attenuato, dentibus lanceolatis acuminatis purpureo-scariosis. Petala dentata non contigua; lamina obovato-cuneata truncata rosea, = $\frac{1}{2}$ unguis.

b. vivariensis, *Jord.* (sp.) *ex Nym. Consp. Fl. Europ.* p. 105.

Hab. Pyrenees.

213. D. PROCUMBENS, *Vent. Jard. Cels*, t. 39; *Pers. Syn.* i. p. 494.

Glaucus, scaber. Caules 30 centim., tetragoni. Folia elongato-linearia plana stricta carinata; radicalia 25 mm. acuminata; caulina 14 mm. acuta, vagina folii diam. bis longiore. Bracteæ patentes ad calycis apices, exterioribus lanceolatis, interioribus obovatis. Calyx purpureus, dentibus lanceolatis acuminatis. Petala dentata non contigua; lamina obovata, = $\frac{1}{4}$ unguis.

Geogr. limits.—*N.* Valley of the Euphrates, near Suwerek in prov. Diarbekir.
S. South of the ruins of Palmyra, in the Syrian Desert.
E. Mt. Elburz, in North Persia.
W. Anti-Lebanon, towards the city of Damascus.

214. D. LEUCOPHÆUS, *Sibth. et Sm. Fl. Græca*, v. p. 3, t. 405; *Boiss. Fl. Orient.* i. p. 487.

Cæspitosus, glaucus, glaber. Caules 13 centim., tetragoni uniflori parce foliati. Folia 20 mm. 3-nervia, lineari-lanceolata acuta adpressa, vagina folii diam. æquante. Bracteæ adpressæ ad $\frac{1}{3}$ calycis, exterioribus lanceolatis, interioribus obovatis. Calyx fuscus apice attenuato, dentibus lanceolatis acutis. Petala contigua obtuse dentata; lamina obovato-oblonga alba, subtus ferrugineo-fusca, = $\frac{1}{2}$ unguis. Antheræ albidæ.

b. macropetalon, *Clem. in Tchihat. Asie Min. Bot.* i. p. 220; *auct. Enum. sp. varr. Dianthus*, p. 20.

Petala latiora; lamina purpurea, subtus pallidiore, = unguem.

c. eretmopetalus, *Stapf* (sp.), *Beitr. Fl. Lycien.* p. 5.

Lamina obovato-cuneata, = $\frac{1}{3}$ unguis.

Hab. Anatolia.

215. D. ANATOLICUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 22; *Fl. Orient.* i. p. 489.

Cæspitosus, scabridus. Caules 35 centim., teretes uniflori. Folia 3-nervia acuminata; radicalia 30 mm. linearia plana patentia; caulina 24 mm. anguste linearia canaliculata adpressa, vagina fusca folii diam. æquante. Bracteæ adpressæ ad dimidium calycem obovatæ. Calyx apice attenuato, dentibus lanceolatis acutis scarioso-marginatis 9–11-nerviis ciliolatis. Petala contigua obtuse dentata; lamina oblongo-spathulata rosea, subtus flavida, $=\frac{1}{3}$ unguis.

Hab. Anatolia and N.W. India.

b. parviflorus, *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 22; *Fl. Orient.* i. p. 490

Flores minimi. Lamina oblonga.

Hab. Turkish Armenia.

216. D. KOTSCHYANUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. viii. p. 68; *Fl. Orient.* i. p. 489.

Cæspitosus, glaber. Caules 25 centim., teretes tenues. Folia acuminata; radicalia 30 mm. 7-nervia linearia plana patentia; caulina 20 mm. 5-nervia anguste linearia canaliculata adpressa, vagina folii diam. æquante. Flores parvi, albi. Bracteæ adpressæ ad dimidium calycem, exterioribus ovalibus, interioribus obovatis. Calyx apice attenuato, dentibus ovatis obtusis scarioso-marginatis 9–11-nerviis ciliolatis. Petala contigua integra; lamina oblonga, $=\frac{1}{3}$ unguis.

Geogr. limits.—*N.* Kurdistan. *E.* Kurdistan.
S. Cilicia. *W.* Anatolia.

Subsectio 4. *Pungentes.*

Caules simplices. Bracteæ acuminatæ.

* Folia patentia, 3–7-nervia. Bracteæ scarioso-marginatæ.

217. D. GRANITICUS, *Jord. in Willk. Ic. Descr. Pl. Nov. Hisp.* i. (1853), p. 15, t. 8; *auct. Pinks West. Eur.* p. 43.

Infra scaber, supra glaber. Caules 15 centim., tenues 4-angulares. Folia linearia acuta 3-nervia, vagina folii diam. æquante. Flores solitarii v. geminati. Bracteæ inferiores lanceolatæ, interiores ovatæ, patentes ad dimidium calycem. Calyx purpureus, dentibus ovalibus acutis. Petala dentata

non contigua; lamina obovato-cuneata purpurea, subtus pallidiore. Antheræ elliptico-oblongæ, cærulescentes.

b. longistylus, *Coste, in Bull. Soc. Bot. France*, xxxviii. (1892) p. 58.

Habitu tenuior. Flores multum minores. Styli longe exserti.

Geogr. limits.—*N.* Gironde, 45°. *E.* Gard, 5° E.
S. Pyrenees, 43°. *W.* Gironde, 0°.

This species has been joined by some French botanists with *D. hirtus*, but it affects a very different soil, occurring in fissures of rocks and sandy ledges of granitic formation, whereas the latter occurs on limestone cliffs in the zone of *Olea europæa.*

218. D. SERRATUS, *Lapeyr. Abr. Hist. Pl. Pyren.* p. 241; *Rouy, in Journ. de Bot.* (1892) p. 47; *Timb. Monogr. Dianth. Pyren.* p. 13, t. 15 (D. subulatus).

Cæspitosus, glaucus, glaber, basi suffrutescens. Caules 20 centim., 1–2-flori, 4-angulares. Folia anguste linearia subpungentia 3-nervia stricta, vagina folii diam. triplo longiore; radicalia 24 mm., reliqua 30 mm. Flores sæpe geminati. Bracteæ lanceolatæ acuminato-cuspidatæ patentes ad dimidium calycem, æquales. Calyx rubellus apice attenuato, dentibus lanceolatis acuminatis membranaceis. Petala dentata non contigua; lamina obovato-cuneata, rosea. Antheræ ellipticæ.

Hab. French Pyrenees and Swiss Alps.

219. D. ACUMINATUS, *mihi, Enum. spp. varr. Dianthus*, p. 21.

Cæspitosus, glaber. Caules 35 centim., teretes basi lignescentes. Folia anguste linearia acuminata 5-nervia, inferiora 45 mm. recurva, superiora 18 mm. incurva, vagina folii diam. æquante. Bracteæ lanceolatæ ad dimidium calycem. Calyx dentibus lanceolatis acuminatis scarioso-marginatis 9-nerviis. (Herb. Mus. Brit. *Aucher-Eloy*, no. 526).

Hab. Elwend, in Syria.

A plant with this name is mentioned in De Candolle's Prodr. vol. i., but cannot be identified with any known species. I have revived the name for this Syrian plant.

220. D. SPHACIOTICUS, *Boiss. et Heldr. Diagn. Pl. Nov. Or.* ser. I. viii. p. 70; *Boiss. Fl. Orient.* i. p. 488; *Raulin, Crit. Cretic.* t. 7.

Cæspitosus, glaber. Caudices procumbentes. Caules 6 centim., uniflori 4-angulares tenues. Folia 5 mm., minima ovato-oblonga acuta 3-nervia stricta, summis lineari-oblongis, vagina folii diam. æquante. Bracteæ oblongæ adpressæ ad $\frac{1}{3}$ calycis. Calyx viridi-rubellus apice attenuato, dentibus lanceolatis acutis. Petala integra non contigua; lamina obovato-cuneata, rosea, $=\frac{1}{4}$ unguis.

Hab. Crete.

221. D. BENEARNENSIS, *Lor. in Bull. Soc. Bot. France*, v. (1858) p. 327, t. 1; *Walp. Ann.* vii. p. 260.

Glaber. Caules 20 centim., tenues teretes uniflori. Folia 25 mm., ligulata incurva, vagina folii diam. æquante. Bracteæ obovatæ adpressæ ad dimidium calycem. Calyx apice attenuato, dentibus lanceolatis acuminatis 7-nerviis. Petala dentata contigua; lamina obovata, rosea, $=\frac{1}{3}$ unguis.

Hab. S.W. France.

** Folia caulina adpressa 3–7-nervia. Bracteæ scarioso-marginatæ.

222. D. ANTICARIUS, *Boiss. et Reut. Pug. Plant.* p. 19; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 681; *Willk. Icon. Descr. Pl. Nov. Rar. Hisp.* i. p. 20, t. 11.

Glaucus, pubescens, basi suffrutescens. Caules 50 centim., tetragoni stricti. Folia lineari-lanceolata acuta plana 5-nervia, vagina folii diam. bis longiore, radicalia 40 mm., caulina 33 mm. Flores cymis laxis. Bracteæ subherbaceæ ovatæ patentes ad dimidium calycem. Calyx purpureus, dentibus lanceolatis acutatis membranaceo-marginatis 11-nerviis. Petala dentata non contigua; lamina obovato-cuneata, rubra, $=\frac{1}{3}$ unguis. Antheræ elliptico-lineares, violascentes.

Hab. Sierra de Antequera, prov. Cordoba.

223. D. PUNGENS, *Gren. et Godr. Fl. de France*, i. p. 234; *Willk. et Lange, Prodr. Fl. Hisp.* iii. p. 682; *Willk. Icon. Descr. Pl. Nov. Rar. Hisp.* i. p. 13, t. 6.

Cæspitosus, glaber, læte virens aut glaucescens, basi suffrutescens, 26 centim. Rhizoma crassum turionibus foliosis. Caules 1–3-flori (sicut superne furcati) angulati stricti tenues. Folia 3-nervia linearia pungentia plana stricta, vaginis brevibus, radicalia 12 mm. acuta, caulina 9 mm. acuminata. Flores

parvi. Bracteæ subherbaceæ, inferiores lanceolatæ, interiores ovales, patentes ad dimidium calycem. Calyx viridescens apice attenuato, dentibus lanceolatis obtuse mucronatis membranaceo-marginatis 9–11-nerviis. Petala inæquali-dentata non contigua; lamina obovata-cuneata, rosea, $=\frac{1}{2}$ unguis. Antheræ oblongæ, luteæ. Capsula dentibus obtusis. Semina granulata.

Geogr. limits.—*N.* Prov. of Dauphiny, in France, 45°.
S. Prov. of Valencia, in Spain, 38°.
E. Piedmont, 9°.
W. Pyrenees, 1° W.

224. D. LEPTOLOMA, *Steud. in Pl. Schimp. Abyssin.* (1761), *ex A. Rich. Tent. Fl. Abyssin.* i. p. 42; *Walp. Ann.* ii. p. 99.

Glaucus, glaber, 27 centim. Folia anguste linearia acuminata plana. Flores solitarii. Bracteæ ovatæ patentes ad dimidium calycem. Calyx dentibus ovatis obtusis membranaceo-marginatis. Petala inæqualiter erosa, lamina obovato-cuneata rosea.

Hab. Abyssinia.

225. D. LACTIFLORUS, *Fenzl, in Tchihat. Asie Min. Bot.* i. p. 215; *Boiss. Fl. Orient.* i. p. 486.

Cæspitosus, glaber. Caules 30 centim., interdum superne ramosi, teretes triflori, sæpe uniflori. Folia 5–7-nervia; radicalia linearia acuta stricta plana, superiora angustius linearia acuminata carinata, vagina folii diam. duplo longiore. Bracteæ exteriores ellipticæ, interiores latiores, viridi-purpurascentes, adpressæ ad dimidium calycem. Calyx dentibus lanceolatis acuminatis ciliolatis scarioso-marginatis 7–9-nerviis inferne viridi-purpurascentibus. Petala integra lactea; lamina obovata. Semina lævia.

Hab. Cilicia and N. Syria.

226. D. BORNMUELLERI, *Haussk. Pl. Exsicc. Anatoliæ Orient.* 1889 (*ined.*).

Cæspitosus, scaber, 20 centim. Caules 1–2-flori. Folia elongato-linearia acuminata stricta 3-nervia, vagina folii diam. duplo longiore. Bracteæ exteriores lanceolato-ovatæ, interiores ovales, cuspidatæ adpressæ ad $\frac{1}{3}$ calycis. Calyx purpureus, dentibus lanceolatis acuminatis 7-nerviis. Lamina obovato-cuneata, $=\frac{1}{2}$ unguis.

Hab. Amasia; on the summit of Abadsihi-dagh.

This species is described from Haussknecht's specimens in Herb. Kew, dated 3 July, 1889, and labelled no. 981.

*** Folia caulina patentia uninervia. Bracteæ scarioso-marginatæ.

227. D. JUDAICUS, *Boiss. Diagn. Pl. Nov. Or.* ser. I. viii. p. 66; *Fl. Orient.* i. p. 485.

Cæspitosus, tomentellus, glaucus. Caules 18 centim., 4-angulares uniflori. Folia linearia acuta carinata recurva, vagina folii diam. æquante, radicalia 12 mm., superiora 20 mm. Bracteæ oblongæ patentes ad $\frac{1}{3}$ calycis. Calyx apice attenuato, dentibus lanceolatis acutis ciliolatis. Petala integra lactea non contigua; lamina oblonga, $=\frac{1}{4}$ unguis.

Hab. Judæa, on the road from Jerusalem to Jericho.

228. D. LIBOSCHITZIANUS, *Ser. in DC. Prodr.* i. p. 360; *Boiss. Fl. Orient.* i. p. 487.

Cæspitosus, glaber. Caules 20 centim., 4-angulares uniflori. Folia anguste linearia acuminata flaccida subincurva canaliculata, vagina folii diam. duplo longiore, inferiora 50 mm., superiora 40 mm. Bracteæ cuspidato-subulatæ adpressæ ad dimidium calycem, inferiores ovato-lanceolatæ, superiores lanceolatæ. Calyx apice attenuato, dentibus lanceolatis acuminatis. Petala obtuse dentata non contigua alba v. pallide rosea; lamina obovata margine incurva, $=\frac{1}{3}$ unguis.

b. multicaulis, *Boiss. et Huet, Diagn. Pl. Nov. Or.* ser. II. v. p. 53; *Boiss. Fl. Orient.* i. p. 487.

Caules 12 centim. numerosi. Folia tenuiora. Bracteæ rubræ. Calyx ruber, 14 mm., dentibus acutis ciliolatis.

Subvar. alba, *mihi.*—Lamina albida.

Subvar. rosea, *mihi.*—Lamina intense rosea.

Hab. Transcaucasia and Turkish Armenia.

229. D. INTEGERRIMUS, *Bunge, in Pl. Abich*, no. 66; *Boiss. Fl. Orient.* i. p. 487 (D. Liboschitzianus, *var.* integerrimus).

Cæspitosus, glaber, pumilus. Caules tenues foliosi superne parce subramosi. Folia 25 mm., linearia acuminata flaccida subincurva canaliculata, vagina folii diam. 3-plo longiore. Bracteæ oblongo-lanceolatæ calycem subæquantes. Calyx apice attenuato, dentibus lanceolatis mucronatis ciliolatis. Petala integra non contigua rosea; lamina obovata, $=\frac{1}{3}$ unguis.

Hab. Russian Armenia.

b. micranthus, *Boiss. Fl. Orient., Supplem.* p. 76.

Flores minores angustiores.

Subsectio 5. *Gymnocalyx.*

Caules ramosi. Bracteæ minutæ scariosæ adpressæ, aristâ incurrente $\frac{1}{5}$ calycis tubum.

230. D. CINNAMOMEUS, *Sibth. et Sm. Fl. Græca*, iv. p. 88, t. 400; *Griseb. Spicil. Fl. Rumel. Bithyn.* i. p. 191.

Cæspitosus, glaucus, glaber lanatus v. papilloso-puberulus. Caules 30 centim., teretes paniculato-corymbosi. Folia linearia obtusa plana flaccida 3-nervia; radicalia 25 mm. patentia recurva, vagina folii diam. duplo longiore; caulina 13 mm. patentia incurva, vagina folii diam. æquante. Flores vespertini. Bracteæ oblongo-ovatæ mucronatæ. Calyx dentibus lanceolatis acutis ciliolatis. Petala irregulariter dentata v. crenata non contigua; lamina obovato-cuneata, supra alba v. rosea, infra purpureo-virente, $=\frac{1}{2}$ unguis. Antheræ albidæ.

a. pubescens, *mihi.*

b. glaber, *mihi*=D. pallens, *Sibth. et Sm. Fl. Græca*, iv. t. 399; =D. bicolor, *Bieb. Fl. Taur.-Cauc.* i. p. 329.

Bracteæ obovato-lanceolatæ. Petala pallidiora.

Geogr. limits.—*N.* Caucasus.
S. Karamania, in Asia Minor.
E. Prov. of Ghilân, in Persia.
W. Servia.

This species was first known from Greece, and is very near the obscure Linnean species *D. pomeridianus*, a plant which cannot now be identified from the description given.

231. D. LEPTOPETALUS, *Willd. Enum. Hort. Berolin.* p. 468; *Boiss. Fl. Orient.* i. p. 484; *Sims, Bot. Mag.* t. 1739.

Glaber. Caules 35 centim., teretes 2–3-flori. Folia elongato-linearia acuminata carinata incurva patentia, radicalia 50 mm., vagina folii diam. æquante. Flores vespertini odorati longe pedunculati. Bracteæ obtuse mucronulatæ, interiores obovatæ, inferiores obovato-lanceolatæ. Calyx apice attenuato, dentibus lanceolatis acuminatis scarioso-alatis ciliolatis. Petala integra v. subretusa non contigua; lamina spathulata undulato-tenui, supra albo-flavida, subtus plumbea, =unguem.

Geogr. limits.—*N.* Along the R. Irtysch, in Siberia.
S. Despoto-dagh, in Rumelia.

E. Soungaria, between the Altai Mnts. and Thian-Shan range.
W. Rumelia.

232. D. RHODOPEUS, *Velen. Pl. Nov. Bulgar. in Sitzungsb. k. Böhm. Gesellsch. Wissensch.* 1890, p. 40.

Cæspitosus, glaucus, glaber. Caules tenues teretes, ramulis unifloris. Folia lineari-lanceolata obtusa plana patentia, vagina folii diam. æquante. Bracteæ oblongo-lanceolatæ acutæ. Calyx dentibus lineari-lanceolatis acuminatis. Lamina lineari-spathulata, carnea.

Hab. Near Philippopolis, and on the slopes of Mt. Rhodope above Dermendere.

Subgenus III. PROLIFERASTRUM.

Herbæ annuæ. Folia bracteiformia (suprema) sub floribus densa submembranacea. Flores capitati. Bracteæ 2–4. Calyx 15-costatus, superne pentagono-attenuatus. Petala retusa. Torus parvus. Capsula oblonga vel ellipsoidea.

* Bracteæ acuminatæ. Calyx verruculosus, dentibus acuminatis. Semina lævia.

233. D. CYRI, *Fisch. et Mey. Ind. Sem. Hort. Petrop.* iv. p. 34; *Boiss. Diagn. Pl. Nov. Or.* ser. I. i. p. 18 (D. macrolepis).

Glaucus, glaber. Caules 24 centim., ramosi angulariter compressi tenues. Folia linearia stricta plana 3-nervia, vagina folii diam. æquante; radicalia 30 mm. obtusa patentia, caulina 24 mm. acuta adpressa. Bracteæ 4 ovatæ scarioso-marginatæ, calycem superantes. Calyx dentibus lanceolatis scarioso-marginatis. Lamina oblonga, rosea.

Geogr. limits.—*N.* R. Kur (Cyrus), in Transcaucasia.
S. Tel-el-Kebir, in Lower Egypt.
E. Kandahar, in Afghanistan.
W. Anatolia.

** Bracteæ mucronatæ. Calyx striatus, dentibus obtusis. Semina non lævia.

234. D. NICOLAI, *Beck et Szyszyl. Pl. Cernag.* (1888) p. 65, t. 3.

Glaucus, glaber. Caules 44 centim., ramosi, infra teretes,

supra subangulati. Folia linearia acuminata erecto-patentia, vagina folii diam. 4-plo longiore. Bracteæ 4 coriaceæ subrotundæ cuspidatæ ad dimidium calycem. Calyx dentibus oblongis scarioso-marginatis. Lamina ovata, alba.

b. brachyanthus, *Vandas, in Sitzungsb. k. Böhm. Gesellsch. Wissensch.* 1890, p. 256.

Hab. Mt. Dziebeze in Montenegro; and (*b*) Mt. Porim in Herzegovina.

235. D. GLUMACEUS, *Bory et Chaub. Fl. Pélop.* p. 340, ic. 65, no. 664; *Boiss. Fl. Orient.* i. p. 517.

Glaber. Folia inferiora dilatato-spathulata, caulina linearia, vagina folii diam. æquante; phylla involucri mucronata. Bracteæ 2 adpressæ ad dimidium calycem punctulatæ. Lamina purpurea, $=\frac{1}{2}$ unguis. Semina rugulosa.

Geogr. limits.—*N.* Mt. Zimjepolje, in Bosnia.
S. Messenia, in Morea.
E. Ruins of Mycenæ, in Morea.
W. Mt. Zimjepolje, in Bosnia.

236. D. OBCORDATUS, *Marg. et Reut. in Mém. Soc. Phys. Genèv.* viii. (1838–40), p. 281, t. 2 (*Essai d'une Flore de l'île de Zante*); *Boiss. Fl. Orient.* i. p. 517 (Tunica glumacea, *var.* obcordata); *Reichb. Ic. Fl. Germ. Helv.* f. 5009 *b*.

Glaber. Caulis sulcatus tetragono-compressus. Folia infima lanceolata obtusa, reliqua linearia acuta, vagina folii diam. æquante; phylla involucri mucronata ad florum apices. Flores inodori. Bracteæ 2 patentes, calycem occultantes. Calyx dentibus ovatis. Petala non contigua; lamina obcordata, purpurea, $=\frac{1}{3}$ unguis. Semina reticulata.

Geogr. limits.—*N.* Istria, in Austria, 45°.
S. Island of Zante, 38°.
E. Nome of Argolis, in Greece.
W. Istria, in Austria, 14°.

237. D. PROLIFER, *Linn. Sp. Plantarum*, ed. I. p. 410; *Tanfani, in Parl. Fl. Italiana*, ix. p. 294 (Tunica prolifera); *Engl. Bot.* ed. III. ii. p. 51, t. 196.

Glaber. Caules 50 centim., simplices vel stricte ramosi erecti graciles, supra angulares, infra teretes. Folia plana; radicalia 17 mm. dilatato-spathulata recurva; caulina 15 mm. linearia acuta incurva sursum decrescentia, vagina folii diam. æquante;

phylla involucri elliptica, exteriora mucronata, interiora obtusa punctulata longiora ferruginea, flores occultantia. Flores parvi inodori breviter pedicellati. Bracteæ 2 stramineæ patentes calycis tubum æquantes, obovatæ vel obovato-lanceolatæ. Calyx gracilis, dentibus lanceolato-obovatis membranaceis. Petala contigua; lamina obovata, carneo-lilacina, $=\frac{1}{3}$ unguis. Antheræ ellipticæ, purpureæ. Semina granulata.

a. typicus (cf. *Reichb. Ic. Fl. Germ. Helv.* f. 5009).

b. nanus, *Godr. Fl. de Lorraine*, ed. II. (1861) i. p. 105.

c. scabrifolius, *Clav. Fl. de la Gironde*, p. 156 (1882).

d. lævis, *Clav. loc. cit.*

Geogr. limits.—*N.* Skâne, in Sweden, 60°.
S. Canary Isles, 30°.
E. Baku, on the Caspian Sea, 50°.
W. Madeira, 17°.

In the 'Flora Berolinensis' the genus *Kohlrauschia* was founded upon this species, and the following points of generic distinction were relied upon by Kunth for its separation from the Linnean genus:—"Flores capitato-congesti rarissime solitarii sessiles involucro universali scarioso cincti. Bracteæ 2 scariosæ convolutæ. Calyx pentagono-tubulosus 15-costatus, inter angulos fere omnino scarioso-membranaceus, apice attenuato. Corolla caryophyllacea; petala retusa lamina suberecta ungue longa lineolataque. Capsula maturescens lateraliter fissus usque ad basin, oblongo-fusiformis."

Seguier's figure wrongly depicts the bracts as acute; in living specimens they are most distinctly mucronate, like the involucral leaves, which consist usually of three pairs inclosing the flower-head. There is no perennial rootstock, or barren leafy shoots; and each stem or fork terminates in a small ovate-fusiform head of flowers. Dr. Boswell-Syme, in the third edition of 'English Botany,' says that in all the specimens he had an opportunity of dissecting he was able to find only one bract to the calyx,—but they may not have been perfect specimens.

The Linnean *D. diminutus* is sometimes given as a variety of this species, and is sometimes placed after it as specifically distinct. It may be as well once and for all to say, as Koch indicates, that the description is based upon an error of observation, and no such plant exists. There is no specimen with this name in the herbarium of Linnæus.

238. D. VELUTINUS, *Guss. Ind. Sem. Hort. Boccadif.* (1825) p. 2, *et Pl. Rar.* (1826) p. 166, t. 32; *Tanfani, in Parl. Fl. Italiana*, ix. p. 297 (Tunica velutina); *Reichb. Ic. Fl. Germ. Helv.* f. 5010.

Velutinus. Caules 40 centim., simplices stricti graciles, supra angulares, infra teretes. Folia plana; radicalia lanceolato-linearia recurva, caulina linearia acuta stricta patentia, sursum descrescentia, vagina folii diam. duplo longiore; phylla involucri epunctulata mucronulata flores occultantia, exteriora dilute ferruginea ovalia, reliqua elliptica. Inflorescentia capitulis 5–8 florum inodororum. Bracteæ 2 phyllis similes. Calyx submembranaceus, dentibus obovatis. Petala contigua; lamina obovata, rosea, $=\frac{1}{3}$ unguis. Antheræ ovales, cæruleæ. Semina valde tuberculata.

Geogr. limits.—*N.* Crimea, 46°. *E.* Armenia, 47°.
S. Algeria, 34°. *W.* N. Portugal, 8°.

NOTE.—Of the 238 species here described, plates are cited for 115 species: in addition 240 varieties are described, and of these plates are cited for 62. Where a figure is obviously bad and misleading, I have not thought it worth while to refer to it. I have not always cited what may appear to be the best plate, but, for convenience of reference and to facilitate the comparison of species, have preferred to quote works in which several species are figured, such as the 'Flora Græca,' Reichenbach's 'Ic. Flor. Germ. Helvet.,' and Willkomm's sumptuous 'Icones.'

HYBRIDS.

The species of *Dianthus* hybridize easily; unlike the genus *Silene*, in which the species hybridize with difficulty. When the pollen of different species reaches the stigma at the same time, and if that which reaches it later has a greater sexual affinity, it can only be potent when the first is not potent or acts injuriously. In *Malva* and *Hibiscus* the production of hybrids can no longer be prevented by their own pollen after three hours, and in *Dianthus* after five or six hours. When two species, A and B, hybridize, and the one species A exercises a greater difference on the form and properties of the hybrid than the other species B, the hybrid, or its descendants, if fertilized by A, will revert more quickly to the parent-form A than it will to the parent-form B if fertilized by it. Thus, according to Gärtner, the progeny of *D. pulchello-arenarius* is more variable than that of *D. arenario-*

pulchellus, and the hybrid of *D. sinensis* and *D. Caryophyllus* reverts to the latter form after 3 or 4 generations, if repeatedly fertilized by it, while it requires fertilization for 5 or 6 generations by *D. sinensis* in order to revert to that form. Again quoting from Gärtner:—"Hybrids usually vary less in the species and varieties of *Dianthus* in the first generation, the less the degree of affinity between their parent-forms; species-hybrids therefore less than variety-hybrids; the former are often characterized by a greater uniformity, the latter by a greater variability. When hybrids are self-fertilized, the variability increases in the second and succeeding generations the more completely it was absent from the first; and three different varieties arise more certainly the less the affinity between the parent-forms." Hybridity in this genus is a study in itself. I have not given any attention to the subject, but simply append a list of hybrids which have received distinct names, just as I find them, some of which of course have in the first place been described as good species.

× *decrescens*, Borb. = deltoides + sinensis, *var.* asper (Seguieri).
× *Dufftii*, Haussk. = Carthusianorum + deltoides.
× *fallax*, Kern. = alpinus + deltoides.
× *Gremblichii*, Asch. = sinensis + Caryophyllus.
× *Guliæ*, Janka = Carthusianorum, *var.* ferrugineus + liburnicus.
× *Hellwigii*, Borb. = Armeria + deltoides.
× *Jaczonis*, Asch. = deltoides + superbus.
× *Leitgebii*, Reichardt = barbatus + superbus (vide *Wolfii*).
× *Levieri*, Borb. = liburnicus + sylvestris.
× *Lucæ*, Asch. = Carthusianorum + arenarius.
× *membranaceus*, Borb. = collinus + diutinus.
× *Mikii*, Reichardt = barbatus + monspessulanus.
× *œnipontanus*, Kern. = alpinus + superbus.
× *saxatilis*, Pers. = sinensis, *var.* asper (Seguieri) + monspessulanus.
× *spurius*, Kern. = Carthusianorum + sylvestris, *Wulf.*
× *Vukotinovicii*, Borb. = Carthusianorum + caryophylloides, *Rchb.*
× *Warionii*, Timb. = fimbriatus + monspessulanus.
× *Wolfii*, Vetter = barbatus + superbus.

SPECIES CANDOLLEANÆ.

In the 'Prodromus,' vol. i. pp. 355–365, De Candolle enumerates 113 species. It will be interesting to scrutinize this list with the view of comparing the number of good species with those which are at present known and recognized. Of the 113 there given, 66 are maintained as species in the present monograph; the other 47 are to be accounted for by a process of elimination. Of these, thirteen cannot be identified at all; they include:—*D. armerioides*, Rafin., *clavatus*, Desf., *grandiflorus*, Poir., *Hornemanni*, Ser., *marginatus*, Poir., *pomeridianus*, Linn., *pumilus*, Vahl, *punctatus*, Spreng., *pungens*, Linn., *silenoides*, Poir., *Sternbergii*, Schleich., *suavis*, Willd., and *virgineus*, Linn.

One is a garden form,—

D. latifolius, Willd.

One is a hybrid,—

D. saxatilis, Pers. (=collinus+monspessulanus).

Two species are to be referred to other genera; they are:—

D. carolinianus, Walt.=Dodecatheon Meadia, *Linn.*

D. spinosus, Desf.=Acanthophyllum spinosum, *C. A. Mey.*

Seven are absorbed in *D. sinensis*, viz.:—

D. alpestris, Balb.; *asper*, Willd.; *caucaseus*, Sims; *Fischeri*, Spreng.; *ibericus*, Willd.; *montanus*, Bieb.; *ruthenicus*, Roem.

Six names are sunk, as being synonyms of other species, viz.:—

Burchellii, Ser.=crenatus, *Thunb.*

cephalotes, Ser.=capitatus, *Balb.*

divaricatus, Urv.=tripunctatus, *S. et S.*

Mussini, Hornem.=squarrosus, *Bieb.* ?

purpureus, Lam.=pungens, *Gren. et Godr.* ?

suffruticosa, Willd.=Bisignani, *Ten.* ?

The remaining 17 species enumerated are reduced to the rank of varieties, and are as follows:—

aggregatus, Poir.=barbatus, *var.* aggregatus.

Balbisii, Ser.= Carthusianorum, *var.* glaucophyllus, *Wierzb.*

bicolor, Bieb., *monadelphus*, Vent., *ochroleucus*, Fisch., et *pallens*, Sibth. & Sm.=cinnamomeus, *var.* glaber.

biflorus, Sibth. & Sm.=cinnabarinus, *var.* alpinus, *Boiss.*

emarginatus, Ser.=cinnamomeus, *var.* pubescens, *mihi.*
ferrugineus, Mill.=Carthusianorum, *var.* ferrugineus.
guttatus, Bieb.=pratensis, *var.* guttatus.
nazaræus, Clarke,=serratifolius, *var.* nazaræus.
pallidiflorus, Ser.=campestris, *var.* glaber, *Trautv.*
Poiretianus, Ser.=corymbosus, *var.* Poiretianus.
ramosissimus, Pall.=campestris, *var.* glaber, *Trautv.*
scaber, Thunb.=micropetalus, *var.* scaber, *E. Mey.*
sylvaticus, Hoppe,=collinus, *var.* sylvaticus.
sylvestris, auct. (*sensu latiore*).

Species excludendæ et non satis definitæ (post-Candolleanæ).

arrectus, Dumort. Fl. Belg. p. 106.
autumnalis, Kit. in Linnæa, xxxiii. (1863) p. 530.
Calverti, Boiss. in Tchihat. Asie Min. Bot. i. p. 223.
Deserti, Kotschy, Pl. Arab. (1865) p. 12, t. 7; Walp. Ann. vii. p. 261.
ellipticus, Turcz. in Bull. Soc. Nat. Mosc. xxvii. (1854) pt. 2, p. 369.
longicalyx, Miq. in Journ. Bot. Néerl. i. (1861) p. 127; Hemsl. in Journ. Linn. Soc. xxiii. (1886) p. 63.
nudiflorus, Griff.=Tunica stricta, *Fisch. et Mey.*
obtusifolius, Scheele in Flora (1843), p. 430.
recticaulis, Ledeb. Fl. Ross. i. p. 287=Tunica stricta, *Fisch. et Mey.*
Sabuli, Kit. in Linnæa, xxxiii. (1863) p. 530.
syriacus, Steud. Nom. Bot. ed. II. i. p. 501=strictus, *Soland. in Russell, Alepp.* (non *Sibth. et Sm. Fl. Græca*, t. 403).
tanaicensis, Gueldenst. Russl. Cauc. Geb. i. p. 110.

INDEX

OF

SPECIES, HYBRIDS, AND SYNONYMS IN THE FOREGOING ENUMERATION, WITH ADDITIONAL SYNONYMS.

Notes upon an Aposporous *Lastrea* (*Nephrodium*).

By C. T. DRUERY, F.L.S.

[Read 3rd November, 1892.]

(PLATE XXXIV.)

THE term apospory has been applied to two abnormal modes of reproduction discovered within the last few years upon certain varietal forms of *Athyrium Filix-fœmina* and *Polystichum angulare*, and subsequently upon some exotic species. In the *Athyrium* (*A. Filix-fœmina*, var. *clarissima*) the usual sites of the sori are occupied by clusters of cellular excrescences furnished with an indusium, and formed by abnormal development of the sporangia. These excrescences, by expansion of their tips, grow out into normal prothalli which produce plants of the approximate parental type when pegged down upon the surface of suitable soil. The spore is thus eliminated from the life-cycle. I exhibit a panful of pinnæ showing the early stages of development of the prothalli. In the case of the Polystichums, of which several examples exist, all of similar type (i.e. *P. angulare*, var. *pulcherrimum*), though found as solitary sports in widely separated localities, a similar type of soral apospory is found upon some of them; but they are further characterized by prothalli being also formed independently altogether of the sorus by simple extension of growth of the apices of the ultimate divisions of the fronds, or more rarely upon extruded venules near their extremities. These prothalli, however, can scarcely be considered as normal, being very eccentric in shape; and though archegonia and antheridia are produced, and plants have been raised by their interaction, these differ widely from the parental type, are weakly in constitution, and irregular in growth or form. The plants which I have raised from the soral outgrowths of *P. angulare*, var. *pulcherrimum*, Moly, are also defective and lacking in vigour. This, however, is not the case with the *Athyrium*, the aposporous offspring of which are robust and fairly typical. It was my good fortune to discover soral apospory in *Athyrium Filix-fœmina*, var. *clarissima*, and Mr. G. B. Wollaston followed with the discovery of apical apospory in *Polystichum angulare*, var. *pulcherrimum*, Padley; and in the latter it will be seen that the life-cycle is still more shortened by the elision of not merely the spore, but of the sporangium and entire soral apparatus.

So far the phenomenon has only been remarked on adult plants,

and the case, therefore, to which my present notes relate is new to the extent (1) that not merely apical, but a sort of pan-apospory has developed itself; (2) that this has appeared upon a young fern seedling only just emerged from the prothallus; and, finally, (3) that the fern is a *Lastrea* or *Nephrodium*, and therefore a distinct species from those already recorded as aposporous.

On July 17, while seeking for bulbils upon a proliferous form of *Trichomanes radicans* kept in a close Wardian case, my attention was attracted by what I at first took for a prothallus developed by a deposited spore upon the tip of a seedling-fern frond near the edge of the pot, a not impossible occurrence, as spores frequently germinate and attain the prothallus stage upon the fronds of Todeas and other filmy ferns under very close conditions of culture. The size of the prothallus, however, which was nearly fully grown, coupled with the extreme youth of the frond which bore it, led to a closer examination; and then I found that it was an actual outgrowth of the frond itself, and that, furthermore, it possessed a feature I had never observed in apical prothalli before when attached to the frond and not pegged down, viz. an abundant crop of root-hairs behind it. These, presumably for lack of a suitable nidus, were brown and partly shrivelled, but the prothallus itself was perfectly green and healthy, and clear indications of an incipient cushion were visible near the sinus by transmitted light. Antheridia were also sparsely visible, but no archegonia. On further examination, I perceived that besides this terminal prothallus a number of rudimentary ones were projecting from the lateral edges of the pinnæ, some of them bearing numerous root-hairs, while a bunch of root-hairs had also been developed behind the tip of one of the pinnæ upon an irregular prothallic outgrowth. The frond upon which this aposporous development appeared was about $\frac{3}{4}$ inch high, including the long stipes attaching it to the prothallus upon which it was engendered. A later frond had formed a similar stipes, and was just commencing to uncoil; this, however, was in too incipient a state to show any trace of prothallic outgrowth. At the base the stump of a third stipes was visible, presumably that of the primary frond thrown up by the prothallus, that bearing the secondary prothalli being distinctly pinnate, which is rarely the case with first fronds.

Owing to the absence of the primary frond and the altogether abnormal character imparted to the second one by its outgrowths,

I was unable at the time of making the sketch which I exhibit to determine its species. In this sketch, which enlarges the plant considerably, the condition of the second frond is given as it appeared in July. Shortly afterwards, as it began to show signs of decay, I placed a small piece of loam behind it to stimulate the prothallic growth, the result of which has been a partial resuscitation accompanied by a splitting up of the terminal prothallus into several smaller ones, but no definite progress in the direction of reproduction.

Meanwhile, however, the next frond in succession grew on, and at first showed no signs whatever of prothallic buds, perfecting, indeed, its normal growth entirely without a sign of them; this completed, however, an irregularity appeared at the top of one of the basal pinnæ, and very speedily others appeared at all points and edges generally, root-hairs and prothalli being developed simultaneously. At this stage, too, the flat surface of the frond along the line of the rhachis broke out into an eruption of small pimples, which very speedily assumed the perfect normal form and size of prothalli; so that at the time of writing (Oct. 23rd, 1892) the upper part of the frond is completely covered by a bunch of prothalli of various sizes, all arising by simple budding and extension of the cellular growth of the frond itself.

At present the next frond in succession presents no abnormality save a terminal expansion and furcation of the rhachis, which, in conjunction with other specific characters now clear enough, proclaim the plant to be a tasselled form of *Lastrea*, presumably the old *L. Pseudo-mas*, var. *cristata*; and this leads me to surmise that apospory in this instance is connected with, and possibly the outcome of, apogamy.

Professor Farlow, when he discovered that phenomenon, found that *Lastrea Pseudo-mas*, var. *cristata*, was constantly apogamous, *i. e.* was constantly produced from the prothallus by simple bud-growth without the sexual interaction of the antheridia and archegonia. That, it will be seen, is precisely the converse of this case, where the sporophore buds out directly into the oophore. Now, assuming such an origin for the plant under notice, it seems to me not at all surprising that, being thus produced by simple bud-growth from a prothallus, it should be to a certain extent unstable, and apt, if grown under specially close and relaxing conditions of culture, as in this case, to revert to the prothallic cell-formation from which it has so recently deviated

in an abnormal manner and *minus* that vital line of demarcation between oophore and sporophore which normally is drawn by the action of the antherozoids upon the archegonial bud.

Upon close examination of the plant which I exhibit, it will be seen not to be alone, a smaller one, exhibiting the same characters in a minor degree, being associated with it. The original prothallus having decayed, I am unable to determine whether both these plants are derived from it; if so, they are sufficiently far apart to point to an apogamous origin, since twin plants normally produced are usually closely attached to each other. According to Prof. Bower* apogamy and apospory undoubtedly occur simultaneously in *Trichomanes alatum*. Finally, I may add that the fern before you has not been in any way stimulated by abnormal warmth, but developed its peculiarities in a close but cold Wardian case.

DESCRIPTION OF PLATE XXXIV.

Young frond of *Lastrea Pseudo-mas*, var. *cristata*, bearing aposporous prothalli. (Natural size ¾ inch.)

a. Terminal prothallus, with profuse root-hairs at back.
b. Incipient cushion.
c. Pinna-tip bearing root-hairs, without any defined prothallus.
pr. Marginal prothalli.
rh. Root-hairs.
d. Stump of primary frond, apparently eaten off.
e. Third frond unfolding.

Note on Sikkim Tree-Ferns. By G. Gammie, Jun., of Mongpo, British Sikkim. (Communicated by C. B. Clarke, F.L.S.)

[Read 3rd November, 1892.]

[The following note was sent to me with the specimens referred to in it, and I communicated it to the Society at the Meeting of 3rd Nov., 1892. Mr. Gammie has a grove of tree-ferns adjoining his Bungalow, and has observed them in every stage of fruit. His note was not quite in form for publication; and I have (at the request of the Council) undertaken the responsibility of editing it. It should be noticed that Mr. Gammie was the first to discover that *Alsophila sikkimensis*, C. B. Clarke et Baker in Journ. Linn. Soc. vol. xxiv. (1888) p. 409, was = *A. ornata*, J. Scott, a

* 'Annals of Botany,' vol. i. p. 300, pl. xvi. fig. 35, &c.

C. T. D. delt

J. N. Fitch lith & imp.

APOSPOROUS FERN.

species that had never been recognized by any one since its original discovery by J. Scott. The arguments by which Mr. Gammie shows that *Hemitelia decipiens*, J. Scott, was really = *Cyathea spinulosa*, Wallich, have been strongly confirmed by specimens (with remarks) received at Kew from Mr. Gustav Mann. The other novel suggestions of Mr. Gammie afford much food for reflection to pteridologists. If Mr. Baker and Col. Beddome have not accepted all the conclusions indicated by Mr. Gammie, it is perhaps because in the tree-ferns, if neither the involucre of the sori nor the venation in the segments of the fronds is to be relied on for classificatory purposes, the definition of any genus or section in the whole group would present great difficulty.—C. B. Clarke, 20th Jan., 1893.]

Alsophila ornata, *J. Scott*,=A. sikkimensis, *C. B. Clarke et Baker*, ?=A. Oldhami, *Bedd.*

In the text appended to the specific description of *A. ornata*, Mr. Scott makes the following remarks:—"*Alsophila ornata* is distinguished from *A. comosa* by its nearly glabrous rhachises and costæ, the latter being scaly below, and in the more compound venation, which is nearly always simple in *A. comosa*; and again in the living plants by its simple or bifurcating caudex void of those adventitious buds so copiously produced by the former, and the large development of woody bundles in the interior of the stem."

It is by no means an absolute rule that *A. Oldhami* should bear fully developed adventitious growths on the caudex; on the contrary, many plants can be found on which they have been produced, but, from some cause, have perished before a single frond has made its appearance. The plants I found of *A. ornata* had either simple caudices or were forked.

On one of them I saw two adventitious growths bearing small fronds; another had produced them in abundance.

Sections taken from simple stems of both species exhibit no difference in the development of the isolated woody bundles in the interior. The arrangement and shape of the lacunæ, the vestiture and colour of the stipes are identical. A few plants of *A. ornata* which I first saw were either totally barren or sparsely soriferous; and I was disposed to imagine that the abnormal development was due to sterility. Subsequently I saw more bearing fronds in full fruit. The barren fronds of these were large, and had the more or less compound venation. The fully fertile segments had all the veinlets simple, or very rarely forked;

others fertile only on the lower third, or less, were similarly veined under the sori, but immediately expanded and resumed the compound venation beyond them. I have seen much-forked veins on segments from what were otherwise typical pinnæ of *A. Oldhami*.

I send a small set of specimens (collected by myself) from fairly representative plants of *A. ornata* and *A. Oldhami*. Extreme forms of both certainly differ; but I do not pretend to be able to perceive where a line can be drawn between the two species.

HEMITELIA DECIPIENS, *J. Scott*.

Mr. Clarke distinguishes this species from *Cyathea spinulosa*, Wall., by the much rarer 3-branched veinlets and the young fruit. He remarks "that the venation should be observed in the segments of the pinnules taken from the middle of a well-developed pinna from a barren frond." A few specimens of the barren pinnæ which accompany this note cannot be included in this species as understood by Mr. Clarke; and still they can be found on almost every plant, either on separate fronds or intermixed with typical pinnæ.

Mr. Scott has noted the variation of the venation; and it is strange that Mr. Clarke should have overlooked it.

I have examined many young fronds, and have found most of the thin membranous involucres ruptured at their apices even in scarcely expanded pinnæ. They are all reduced to more or less hemispheric cups long before the sori are ripe; and in this respect differ from those of *Cyathea spinulosa*, which are said "to dehisce by irregular lines when the sori are ripe."

The fertile pinnæ of *A. Andersoni*, Scott, which I send are interesting, because they show the same tendency to variation.

A few years ago I sent an extremely developed form of *A. glabra* under the name of *A. ornata*. Although differing in such a degree from the type, I have found them growing on the same stem; and this is an instance of variation in tree-ferns which has apparently been unnoticed hitherto.

The Lepchas, who are versed in such matters, invariably apply the name "Dang pashin" to plants of *A. glabra* possessing these abnormal fronds.

As far as I have seen, the liability to vary is most evinced by plants on which barren fronds abound; so that, in my opinion, the larger development of leaf-surface, and consequently of veinlets, is favoured by the sterile condition of the plant.

The specimens which I sent of *A. glabra*, as well as those which I send now of *A. Oldhami*, *ornata*, *Andersoni*, and *Hemitelia decipiens*, seem to prove that the venation in all is too inconstant a character to be more than of secondary importance in distinguishing and separating the species of tree-ferns from each other.

A Theoretical Origin of Endogens from Exogens, through Self-Adaptation to an Aquatic Habit. By the Rev. GEORGE HENSLOW, M.A., F.L.S., &c.

[Read 17th November, 1892.]

GENERAL OBSERVATIONS. *Supposed Order of Descent.*—There seems to have been a general assumption that endogens preceded angiospermous exogens in the evolutionary history of plants; just as vascular cryptogams are presumed to have been the forerunners of gymnosperms; though both these groups appear together in the Devonian strata. Similarly it has been thought that the exogenous *Incompletæ* were the predecessors of the petalous forms. The structure of the flowers of the *Incompletæ* together with a study of their cross affinities lead one to suspect that they are without exception—unless it be *Casuarina*—all degradations from petalous plants *. Thus, *e. g.*, there are many

* See 'Darwinism,' by Mr. A. R. Wallace (*note*, p. 324), where views, similar to my own, of Mr. Grant Allen, are mentioned, together with mine. Prof. Fr. Delpino has arrived at the same conclusion with regard to the *Incompletæ*. He observes:—"Tutti quei gruppi di piante angiosperme che per un complesso di cause, le quali ci sono lucidamente dichiarate dalle indagini biologiche, offrono un singolare depauperamento di organi florali, per esempio i gruppi delle cupulifere, delle corilacee, delle juglandee ecc., sono da molti botanici considerati come tipi più semplici e più antichi.

"Ma in realtà è tutt' altro; e qui si commise l'errore di assumere per tipo di maggiore semplicità ciò che in fondo non è che un tipo di maggior riduzione; di prender per tipo più antico ciò che non è che un tipo di evoluzione comparativamente recente."

The Professor also adds a note discussing the affinities of Exogens with Endogens, in which the following sentence occurs:—"È ben fra le cose possibili che da un tipo affine alle ninfeacee per esempio siasi spiccata una stirpe affine alle idrocaridee, dalla quale a poco si sarebbe venuto concretando un tipo di gigliacea, vale a dire il tipo centrale delle restanti monocotiledoni . . . . La serie naturale delle piante superiori deve essere espressa come segue: felci, ginnosperme, angiosperme dicotiledoni, monocotiledoni." ('Contribuzioni alla Storia dello sviluppo del Regno Vegetale,' I. SMILACEÆ, pp. 77 and 51. Genova, 1880.)

connections between *Caryophylleæ* and the "cyclospermous" orders; similarly the *Euphorbiaceæ* are considered to be "close with *Malvaceæ*" (Hooker), &c.

On the other hand, while the different orders of endogens have affinities among themselves, no systematist at the present day, I believe, recognizes any real points of connection between endogens and exogens *. Hence arises a difficulty in endeavouring to refer the former class to its origin †; especially as Geology lends us little or no aid in any endeavour to trace the history of its descent ‡.

Evidences from Geology.—With reference to any evidence from Geology, it would seem that plants which were at one time supposed to be endogens in the Carboniferous epoch, such as the "palm" *Poacites cocoina*, Lindl. & Hutt., and the "aroid" *Pothocites*, really belonged to gymnosperms, and that true endogens have not been found earlier than the Trias or Permian §.

M. Saporta has described ‖ some fossil plants found in strata above the later Jurassic series at Cercal in Portugal. They appear to have been aquatic in habit. One of the more remarkable is called *Protolemna*, and resembled existing *Lemnæ* in

* Robert Brown considered *Cycadeæ* to be in certain respects "transitum a Monocotyledonibus ad Dicotyledones," and places it in Monocotyledons next to *Hydrocharideæ*. He also thought *Aristolochia* to be "affinitas arctior cum monocotyledonibus quibusdam"; although, following Jussieu, he places it in the Dicotyledons (Prod. Fl. Nov. Holl. pp. 347, 349).

† Prof. Delpino remarks:—"Le vere origini delle monocotiledoni sono tuttora avvolte in quasi completa oscurità" (Smilaceæ, p. 51, *note*).

‡ Although I had long ago come to the general conclusion, but had not collected sufficient materials, that endogens were in some way connected with water, I was glad to see the following observation by Mr. W. Gardner in his paper on *Water-glands* (Proc. Camb. Phil. Soc. 1883, p. 43):—"I should like to put forward a view which has struck me, but upon which I would prefer to lay no stress. Comparing generally the Dicotyledons with the Monocotyledons, it seems to me that whereas the former are typically land-plants in their habit, the latter on the other hand are of essentially an aquatic nature."

§ Thus one of the earliest plants, described by Schimper, occurs in the Trias, and is called *Æthophyllum*. It cannot be assigned to any existing order. It seems to have had a branching woody stem, but one more like that of a grass, agreeing so far rather with bamboos than anything else, and bearing spikelets which were articulated, as is the case with many grasses now. It, however, appears to have been devoid of nodes; in which feature it resembled *Typha*. ('Traité de Paléontologie Végétale,' vol. ii. p. 386.)

‖ Comptes Rendus, cxiii. 1891, p. 249.

some respects, but it was of a higher type, possessing a stem or distinct axis bearing leaves of a very delicate nature and presenting a venation like that of dicotyledons. Another plant, named *Protorrhipis Choffoti*, had a limb with deep indentations, and a palmately-nerved venation with many irregularly-formed meshes, recalling the structure of various organs of dicotyledonous plants. He concludes with the following observations:—"Il me semble qu'il en résulte . . . . que les Angiospermes auraient traversé un état primitif de faiblesse et de subordination, en rapport avec le point de départ originaire de toute la classe. Les Dicotylées de Cercal, encore faiblement différenciées, moins éloignées des Monocotylées qu'elles ne le furent à la suite de l'extension rapide qu'elles prirent un peu plus tard, affectant une nervation dont les cotylédons, les bractées et les parties stipulaires ou involucrales offrent encore des exemples, auraient été plus rapprochées des types herbacés de la classe que des types ou ordres arborescents, plus élaborés et plus arrêtés aussi dans les traits décisifs de leurs organes appendiculaires."

M. Saporta here inclines to the opinion that the simplicity of structure observable in these fossil plants, of which there were about twenty Angiosperms, indicates a more primitive condition; but from the nature of the plants described, I think there can be no doubt that they were partly if not all aquatic, and the "feebly differentiated" structures to have been due to a consequent degeneration, and are not necessarily indicative of a higher ancestry at all.

Survivals.—The belief, however, that endogens are of very early origin—though I shall give reasons for thinking that they were *not* antecedent to exogens—is supported by the fact that so many orders of this class include very few genera. Thus, according to the 'Genera Plantarum' of Bentham and Hooker, there are thirteen orders out of one hundred and sixty-six which have only four or a less number of genera, while two orders have six. Taken together, therefore, these amount to nearly 8 per cent. of the whole class. It need hardly be added that monotypic animals and plants, as well as those orders and genera with but few members, are always regarded as survivals on the principles of evolution and represent a lost ancestry.

Percentages of Aquatic Orders.—Supposing the supposition to be true that endogens were originally derived from exogens through an aquatic habit of life, and that at least many of them

subsequently became terrestrial, one would on *à priori* grounds imagine that there would still be many aquatic endogens which have not yet taken permanently to a terrestrial habit. Such is precisely the case; for of seventy-four British orders of exogens, five only are decidedly aquatic, viz., *Nymphæaceæ*, *Elatinaceæ*, *Halorageæ*, *Lentibularineæ*, and *Ceratophyllaceæ*: while aquatic species are found in several other orders.

On the other hand, there are fifteen British endogenous orders, and of these eight are decidedly aquatic, viz., *Hydrocharideæ*, *Juncaceæ*, *Eriocaulineæ*, *Typhaceæ*, *Lemnaceæ*, *Alismaceæ*, *Naiadaceæ*, and *Cyperaceæ*; while other orders have occasionally aquatic or marsh plants. Hence exogenous aquatic British orders are nearly in the proportion of 7 per cent., whereas in endogens they reach 53 per cent.

If we take a wider survey, as, *e. g.*, of all the orders given in Le Maout and Decaisne's 'Analytical Botany,' we find that out of 224 exogenous orders, 9 may be regarded as aquatic, or 4 per cent.; and of 55 orders of endogens, 18 are aquatic, or nearly 33 per cent.

Such marked contrasts show that there is some decidedly important connection between an aquatic habit and endogenous structures; for since exogens are more than four times as numerous as endogens, the chances in favour of a preponderance of exogens occurring in rivers, lakes, ponds, &c., is much greater than that of endogens. Thus, *e. g.*, Mr. Guppy found about twenty-eight seeds and fragments of plants capable of growing, of exogenous plants in the rivers Thames and Lea; while there were only about fourteen, or just half the number, of endogenous species *.

POINTS OF SIMILARITY BETWEEN ENDOGENS AND EXOGENS. *Roots, Stems, and Pedicels.*—The fact that all the floral organs of endogens are constructed on identically the same lines as those of exogens—their ternary symmetry † being the chief difference—undoubtedly points to a common origin. It is, however, more especially the vegetative system to which I would first draw the reader's attention.

Now points of similarity of structure in different plants are

* "The River Thames as an Agent in Plant Dispersal," Journ. Linn. Soc., Bot. vol. xxix. p. 333.

† I have elsewhere shown how this probably arises out of the $\frac{1}{3}$-phyllotaxis; and this, in turn, is a result of there being only one cotyledon. 'Origin of Floral Structures,' &c. p. 28.

either due to a community of descent and represent affinity, or to similarly adaptive processes. In the case of the two great classes of Phanerogams, Exogens and Endogens, notwithstanding their great and well-known differences, there are several features which they have in common which point to the former rather than the latter. In looking for proofs of a community of descent, one turns always towards the least differentiated structures; and we find them, therefore, in the anatomy of many of the main roots, in the morphology of the stems of seedlings, in peduncles and pedicels, as well as in the floral organs. In the simplest form of roots the arrangement of the elements is exactly the same, each being equally pronounced. Indeed, we may include those of Cryptogams, such as ferns. M. Ph. van Tieghem has described and figured several in his paper on the symmetry of plants *; so that, by looking at his illustrations alone, it would be impossible to say to which class each belonged.

Perhaps the most marked distinction between the two classes lies in the structure of the woody stems; but in such simple organs as pedicels a common arrangement is to have a definite number of cords arranged symmetrically in a circle in both classes, the number only being different. Thus, in a crocus there are six, while a primrose has five. Again, if the flower-stalk of *Anemone coronaria* be compared with that of a daffodil, no appreciable difference is perceptible between them. They both have two ovals of separate cords arranged around a lacuna in the middle.

A similar simplicity is often seen in the first year's growth of herbaceous plants, whenever the fibro-vascular cords are all isolated in a circle round the central medulla. Inter-fascicular cambium may occur and subsequently fill up the interstices, thereby making a complete zone of xylem. We then get the typical exogenous structure. In the case of endogens the characteristic difference likewise takes place at the same stage, in that the subsequent cords are separate, but are now scattered throughout the fundamental tissue. Consequently the cortex, medullary rays, and medulla are not isolated as the cords are developed. The fibro-vascular cords remain, however, oriented as before, the cambium being arrested.

Now this is just what one finds to be the case, in an incipient degree, in an amphibious plant, such as *Bidens cernua*. In the

* "Symmétrie de Structure des Plantes," Ann. des Sci. Nat., Bot. 5 sér. xiii. p. 5, 1870; also 'Traité de Botanique,' vol. i. p. 675.

aquatic submerged stem the cords of the xylem remain separated as isolated masses, while in the terrestrial plant they are united into a compact and continuous zone of wood, though the approximation to an endogen does not proceed further in this case, except in a general degree of degradation.

Again, though ordinary endogenous stems are easily distinguishable from exogenous, in some cases there still remain somewhat pronounced resemblances. Thus in *Taccaceæ*, *Dioscoreæ*, and *Smilaceæ*, it has been observed that the fibro-vascular bundles are arranged with a tolerable degree of regularity around a central pith. Again, Möbius notes "that both the structure and arrangement of the fibro-vascular bundles of German Orchids show a singular approach to exogens. The bundles are in a single ring in the uppermost portion of the stem, and show at least traces of an active cambium." *

Histological Elements.—Besides these morphological facts, histology points to a common descent, in that all the details of the tissues are of the same kind, respectively—parenchyma, prosenchyma, spiral and annular vessels, &c. Each and all can be paralleled in the two classes.

One marked difference lies in the relative degrees of activity of the pericycle, which adds to the increase of the diameter of the stem of *Dracæna* †, &c., in an analogous manner to that of the cambium ring in exogens; but it is now recognized to be much more active in the stems of exogens than formerly, inasmuch as it is the source of the bast or true liber, and many other forms of tissue within the cortex, outside the position of the phloëm ‡.

Lastly, the anatomical details of leaves taken generally are the same in both classes, though the distribution of the ribs and veins may be different. Even with these, resemblances are not wanting, as in the group Lindley called *Dictyogens* among endogens.

On the other hand, indications of an adaptive character are to be

* Quoted from Journ. Roy. Micr. Soc. 1887, p. 428. I have not seen the original paper.

† Sachs regards this as an active zone of fundamental tissue, but it is on the "site" of the pericycle; and that the growth is due to this layer is supported by analogy, as in radishes, beetroot, &c. M. Ph. van Tieghem attributes it to the pericycle.

‡ See M. Morot's paper, Ann. des Sci. Nat., Bot. 7 sér. xx. 1885, p. 234.

seen everywhere, both morphologically and histologically *; and the object I have in view is to show that many of the characters common, more especially, to the vegetative organs of endogens, and regarded as points of affinity, are just those which are characteristic of the adaptations of exogens to an aquatic, and, in some cases, to other habits of life.

POINTS OF DIFFERENCE BETWEEN ENDOGENS AND EXOGENS. *The Embryo.*—The first difference of importance lies in the structure of the embryo, which has supplied the names "Monocotyledons" and "Dicotyledons" to the two Classes; just as the structure of the stems furnishes those of "Endogens" and "Exogens." These I shall consider hereafter.

The first observation to be made is that the development of the embryo from the egg-cell to the proembryonic condition is the same in both dicotyledons and monocotyledons; *i. e.* up to the period, and even beyond it, of the quadrature of the terminal cell. The visible differences begin when the globular proembryo becomes unsymmetrical in monocotyledons. With regard to the origin of the single cotyledon in the latter, M. Ph. van Tieghem observes † that, of the two cells formed by the first longitudinal partition of the embryo-cell at the end of the suspensor, if they are equal in size they lay the foundation of a dicotyledonous embryo, but if they be unequal then the larger one only becomes a cotyledon.

Judging, however, from the numerous figures of proembryos

* It must be borne in mind that there is no fundamental difference between the two classes of characters "adaptive" and those indicating assumed "affinity." It was my contention elsewhere ('Origin of Floral Structures,' &c.) to prove that characters of flowers usually regarded as indicating a common descent, in all cases owe their origin to adaptations to the environment, including the visits of insects; then, when plants have once established their affinities, which are mainly based upon their reproductive organs, other and similar adaptations may appear in both the reproductive and vegetative organs, often in widely different orders. These, therefore, cannot be called characters of affinity. Thus, for example, we find a similar labiate corolla with didynamous stamens in more than one order; the *form* of a pea-blossom is mimicked by species of *Pelargonium*, *Polygala*, and even *Collinsia*; so, too, a pea and a *Bignonia* have foliar tendrils; air-canals with perforated diaphragms occur in aquatic exogens and endogens exactly alike, as well as floating leaves with stomata above and none below, as in *Ranunculus heterophyllus*, *Hydrocharis*, and *Alisma natans*, &c.; but not one of these can be regarded as indicating affinity, they are adaptations alone.

† Ann. des Sci. Nat. 5 sér. tom. xiii. p. 24.

given by Irmisch, Hegelmaier, Hanstein, and others, it does not seem that this idea of equality, or the reverse, in the two cells can be sustained. But that *the energy of growth is arrested in one* and not in the other, appears to be the real interpretation of a monocotyledonous embryo. Hence one only elongates, its superior vigour carrying it on in a straight line with the suspensor, finally making the cotyledon terminal; comparably, perhaps, with a vigorous lateral shoot, as of vine or horsechestnut, which finally assumes an axial direction.

M. Ph. van Tieghem notices that the angular divergence between the cotyledon and the next new organ is 180° (generally in endogens); or, if lateral, 90° (as in exogens). When this latter case occurs in endogens, it implies that the one cotyledon is due to an arrested condition of the other of two opposite cotyledons; so that the first leaf belongs to a second pair decussating in position with the cotyledons. If the first leaf be at 180°, then it would appear to have usurped the position of the cotyledon that is lost; but it is not strictly on the same level as the cotyledon, in as much as the first leaf is completely included within it, as may be seen in *Asparagus*, figured by Irmisch *. The cotyledon corresponds to one of the cords of the root. It receives from the tigellum a single vascular cord which trifurcates on emerging. The second leaf receives also a three-forked cord, and is found to be exactly opposite the cotyledon. The third and fourth leaves are also opposite each other. The left one of the two accompanying diagrams shows their positions; while the arrows indicate the course which the spiral will take when the arrangement of the leaf-scales becomes resolved into the $\frac{2}{5}$ system, as represented by the right-hand diagram. This is, of course, particularly characteristic of phyllotaxis in exogens.

* 'Beiträge zur vergleichenden Morphologie der Pflanzen,' 1854, Taf. vii. figs. 46, 47. R. Brown observed that the first leaf of the plumule in *Aroideæ* is situate opposite to the cotyledon (Prod. Fl. Nov. Holl. p. 334).

As another illustration Sachs figures a transverse section of a shoot of *Aloë Serra**, in which the first six leaves are distichous. The position of the following leaf is shifted through an angle of 36°, so that the successive leaves at once pass into the $\frac{2}{5}$ system, the leaf numbered 13 being over the 8th after 2 coils are completed, the spiral from 1 to 15 being from left to right.

That the tristichous arrangement is also as easily acquired is seen in this being characteristic of *Cyperaceæ*, &c., and probably lays the foundation of the ternary arrangement of the flowers of endogens; consequently the production of a second leaf in the ordinary systems of phyllotaxis *may* be at 120° as well as 180°. Indeed this is probably more often the case than 90°, as M. van Tieghem describes it in *Asparagus*; so that the $\frac{1}{2}$ and $\frac{1}{3}$ arrangements are very common among Monocotyledons, as in grasses, sedges, orchids, &c.†

It is interesting to find that Robert Brown long ago noticed this difference between Dicotyledons and Monocotyledons, that whereas "in Dicotyledonibus ejusdem foliola primaria cum cotyledonibus alternant: in Gramineis et Aroideis contrà, in quibus solummodo e Monocotyledonum classi hanc determinare possumus, cotyledone opponuntur"‡.

"*Dicotyledonous*" *Monocotyledons.*—*Tamus communis* affords a parallel instance to *Asparagus*. Dutrochet§ has shown that the "first leaf" is situated exactly opposite the cotyledon, which remains embedded within the endosperm on germination. He has no hesitation in calling it a second cotyledon. It is very rudimentary, closely applied to the globular epicotyl, has a median nerve, though it is very delicate in texture and translucent. It never turns green, though exposed to light, and dies

* Text-book, 2nd ed. p. 193, fig. 152. I do not think he describes it correctly.

† I have fully explained how the ordinary system of phyllotaxis has arisen in my papers "On the Variations of the Angular Divergences of the Leaves of *Helianthus tuberosus*," Trans. Linn. Soc. vol. xxvi. p. 647; and "On the Origin of the Prevailing System of Phyllotaxis," *op. cit.* 2nd ser. vol. i. p. 37. See also 'Origin of Floral Structures,' chap. ii. p. 7 *seqq.*

‡ Prod. Fl. Nov. Holl. p. 347.

§ "Observations sur la Forme et la Structure primitives des Embryons Végétaux," Nouv. Ann. du Mus. iv. 1835. Graf zu Solms-Laubach gives a series of figures illustrating the growth of the proembryo of *Tamus communis*, well showing the development of one cotyledon and the arrest of the other: Bot. Zeit. 1878, Taf. iv. figs. 21–25.

some days after its appearance. "Il résulte de là que l'embryon séminal du Tamme est véritablement dicotylédon." The next leaf is situate in a plane at right angles to that passing through the cotyledons. The germination, Dutrochet observes, agrees exactly with that of *Asparagus*.

M. Ph. van Tieghem's observation, therefore, appears to afford good reasons for suspecting that the presence of only one cotyledon is simply due to the partial or total arrest of the other. I say partial, for in some cases considerable discussion has arisen concerning the nature of the appendage to the embryo, opposite to the single cotyledon of certain grasses*. Several botanists regard this as a rudimentary cotyledon. M. Ph. van Tieghem's objection to this view is based on the fact that it is devoid of vessels; but this does not seem to me to be of any weight, since, as organs degenerate, so do the fibro-vascular cords tend to, or quite disappear. Thus, while *Primula* has cords in the place of the missing stamens, *Rhamnus* has none, though its stamens are opposite to the petals, as in the former plant. Again, stipules as a rule are provided with cords derived from the lateral members of the vascular system of the petioles; but in some desert species of the *Illecebraceæ*, as *Polycarpon sinaitica* and *Polycarpæa fragilis*, the scarious stipules have no trace of vessels of any kind whatever. Again, a quadrangular papilla occupies the position of the pistil in the male flower of box, and a conical one in that of *Lychnis dioica*; but the cords which should have been supplied to the carpels stop short at some distance below it in the former, and are totally wanting in the latter, &c.

In fact, the presence of cords is a mere question of degree of degeneracy; and considering how feeble the cords are, even in a cotyledon, their function being to convey nutriment to the plumule and radicle, it is just what one would expect, to find them totally absent, when there was no nutriment in the rudiment at their disposal.

"*Monocotyledonous*" *Dicotyledons*.—The question arises, assuming a monocotyledon to have descended from a plant with two cotyledons through an aquatic habit, do we find any instances in support of this view, among existing dicotyledons, which are now aquatic, or have presumably descended from water-plants? More than one order supplies us with such. *Trapa natans*, for

* As in *Ægilops*, Oat, *Lolium temulentum*, &c.

instance, of the *Halorageæ*, is a good illustration. It has one cotyledon which remains within the testa, as is so often the case with endogens, the other being rudimentary. *Ranunculus Ficaria* supplies another case. Though this plant is not now a true aquatic plant, yet it flourishes vigorously by the waterside, and has, I think, without doubt descended from an aquatic plant.

Irmisch * has given a description and plates illustrative of many details of this plant; and adds a feature which I had not noticed, particularly characteristic of endogens. The single cotyledon when fully developed has a long sheathing petiole, forming a closed tube at the base, excepting a small orifice, from which the plumule can escape. It thus forms, as also occurs in *Carum Bulbocastanum*, what Mirbel called a "coleoptile" in endogens.

The peculiarities which seem to warrant the conclusion that *R. Ficaria* was originally an aquatic plant are the lacunæ with symmetrically arranged circumferential cells in the stems and petioles, both having exceedingly lax parenchymatous tissue, and the widely separated cords with deficiency of supportive tissue, the cords becoming anastomosed at the nodes. The cordate form of the leaf resembles that of other floating leaves of true aquatics. The upper epidermis of the leaf is provided with stomata nearly double in number those of the lower side, the chlorophyll being pretty abundant in the cells of the lower epidermis, but very sparing in those of the upper, that is, irrespective of the guard-cells of the stomata.

Lastly, it has one cotyledon, the other being suppressed. This species does not seem to ripen its fruit often in England, but, from some sent me which were apparently ripe, I found most of the seeds to be only half developed, with no discoverable embryos. In one, however, the endosperm was copious, but the embryo had not advanced beyond the proembryonic condition. Hegelmaier also describes and figures it in this condition †. On the other hand, Irmisch figures it with a conduplicate cotyledon remaining within the endosperm during germination. Hence it may be inferred that the cotyledon may exist in different degrees of development, or rather of degradation, in this plant ‡.

* 'Beiträge zur vergleichenden Morphologie der Pflanzen,' pls. i. & ii., 1854.

† 'Vergleichende Untersuchungen über Entwicklung dicotyledoner Keime,' Taf. i. fig. 25.

‡ *Op. cit.* Taf. ii. figs. 1, 2, 6, &c.

As other instances of the so-called "pseudo-monocotyledonous" plants among dicotyledons, Mirbel mentions the "bulbous fumitary," *Bulbocapnos*, Cyclamen, some species of *Cereus*, and *Guarea trichilioides* of the Order *Meliaceæ*. These I have had no opportunity of examining.

It must always be remembered that more than one cause may produce the same or analogous effects in plants; so that while I attribute the total or partial arrest of one cotyledon to an aquatic habit, a similar arrest may arise from atrophy in consequence of the way in which the embryo is folded in the bud. This, I think, is well seen in *Abronia arenaria* *. An analogous case of arrest occurs in the structure of the conduplicate leaf of the lime, in which one side of the base can grow more freely than the other on the expansion of the bud. The result is that the adult leaf is oblique at the base. The same result occurs in the elm. Sometimes the check to growth is carried so far as to completely detach the small basal lobe as a distinct leaflet.

As another instance of degradation, *Utricularia* may be mentioned. Hegelmaier † also describes the embryo of *Erigenia bulbosa*, Nutt., an anomalous umbelliferous plant, which has its embryo greatly reduced, scarcely amounting even to the proembryonic condition.

The most instructive instance, however, would seem to be that of *Carum Bulbocastanum* ‡; for if the reader will compare the series of figures given by Hegelmaier of the development of the embryo of *Sparganium ramosum* § with those by the same author of this umbelliferous plant, which produces a monocotyledonous embryo, it will be seen that there is no appreciable difference between them. The various stages of development up to that of a globular proembryo are identical. Then begins the asymmetrical growth in both alike, by one cotyledon acquiring a more vigorous development in an axial line, so that the now elliptical form of the proembryo bulges a little at the base ‖. Finally, the

* Figured by Sir J. Lubbock, 'On Seedlings,' vol. i. p. 31, fig. 64.

† Vergl. Unters. Entw. dicot. Keime, p. 144, Taf. viii. figs. 1–2.

‡ *Op. cit.* Taf. vii. figs. 28–41.

§ Bot. Zeit. 1874, Taf. 10.

‖ *Cf. op. cit., e. g.* fig. 38 of *Carum* with fig. 20 of *Sparganium*.

form in *Carum Bulbocastanum* assumes that of the embryo of wheat, as also figured by Hegelmaier *.

We thus see why one cotyledon is terminal and the other nearly basal, namely by the arrest of the development of one cotyledon.

The linear cotyledon described and figured by Irmisch has a prolonged sheath, through an orifice of which the plumule escapes. We thus have the additional feature of a coleoptile characteristic of monocotyledons, just as described in *Ranunculus Ficaria.*

There would seem, therefore, to be no fundamental difference between this embryo and that of wheat, excepting in the deep-seated origin of the primary root of the latter and the presence of its sheath or coleorhiza.

Carum Bulbocastanum and *C. Carui* are not aquatic plants; but there are reasons for thinking that these two species as well as other umbelliferous genera characterized by having *linear cotyledons* and *finely dissected foliage* may have been so ancestrally. Such are, for example, *Cuminum Cyminum*, *Myrrhis odorata*, *Meum athamanticum*, *Scandix Pecten-Veneris*, and fennel; as well as the linear-leaved or phyllodinous *Aciphylla squarrosa* and species of *Bupleurum*.

The resemblance of the cotyledons to that of *Ranunculus heterophyllus* is very marked; while *Œnanthe Phellandrium* furnishes both kinds of dissected foliage, the submerged and aërial, and thus shows how the above-named terrestrial plants may have been aquatic at first.

Drs. Gibelli and Ferrero have lately studied the ovule of *Trapa natans*, L.† From their point of view the mature embryo is to be regarded as an amorphous mass or a true thallome on which is developed a single bud, the plumule. The more general view held is that it is a degraded embryo possessing only a single perfect cotyledon, the second being represented by a minute scale reminding one of a similar scale or lobule in the embryo of some grasses, &c. The authors regard the degradation of the embryo as resembling that which occurs in parasitic and semiparasitic plants such as *Orchideæ*, *Orobanche*, *Cynomorium*,

* Vergl. Unters. Entw. dicot. Keime, *cf.* fig. 4 *b Carum* with fig. 39 of wheat on the same plate. The corresponding figures of *Sparganium* are only partially outlined.

† "Intorno allo sviluppo dell' ovolo e del seme della *Trapa natans*, L." 'Malpighia,' v. 1891, p. 156.

Balanophora, *Monotropa*, *Cuscuta*, &c., and in some aquatic genera, e. g. *Zostera*, *Hydrocharis*, *Utricularia*, and we may add *Ranunculus Ficaria*.

The authors give a useful epitome of the opinions of botanists on the seed of *Trapa*, from Adanson, 1763, to Wittrock in 1887. For example, Gaertner says:—"The cotyledons are unequal, the one being very large and thick, the other minute, subrotund and scale-like, adjacent to the base of the radicle. The plumule is very minute, lying concealed within the small cotyledon." He adds, "It oscillates, like *Nelumbo*, between Monocotyledons and Dicotyledons; and since during germination only a single cotyledon comes to light, strictly speaking it would be associated with Monocotyledons." A. L. de Jussieu (1789) asks whether the one-lobed seed did not show affinity with *Naias*; or rather, being bilobed, with perigynous stamens and corolla, a four-fid calyx and four petals, it ought to be ascribed to the genus *Onagris*. Hofmeister, like other writers, recognizes the great inequality in the size of the cotyledons, the formation of the plumule in a fissure at the base of the cotyledon and covered by a scale, which he regards as the second cotyledon. He says that there is no principal root in *Trapa*, as also is the case with *Ceratophyllum*, *Naiadeæ*, and *Orchideæ*. His associating *Ceratophyllum*, a dicotyledonous aquatic genus, with Monocotyledons is interesting as affording another corroborative instance of an aquatic medium being correlated with an arrested primary root. We shall see, however, that this feature is a general one.

Ceratophyllum illustrates another point. We shall see that the first leaves of the plumule of members of the *Nymphæaceæ* are greatly degraded by arrest; and in this genus the lower leaves of the plumule have even assumed the character of cotyledons. The single cotyledon of *Trapa* is not lateral but terminal as in monocotyledons; and, except in the absence of endosperm, which, however, is a characteristic feature generally of aquatic monocotyledons, the authors observe that the development of the embryo resembles that of typical monocotyledons.

The association by these authors of *Trapa natans* with the embryos of parasitic as well as with those of other aquatic monocotyledons points to another and very potent cause of degeneration, which often produces very similar features in the ovules and seeds and even a greater amount of degradation in the vegetative system, as seen in the total absence of chlorophyll.

Their idea of regarding the embryo of *Trapa* in the light of a *thallus* is paralleled by the view of Agardh with regard to monocotyledons generally. This author raised the question whether it was desirable to regard the embryo of monocotyledons and of dicotyledons as very distinct, and came to the conclusion that a monocotyledonous embryo was a degraded state of a dicotyledonous one; and indeed he uses the same expression "thalloid" for it as now proposed by Drs. Gibelli and Ferrero. He thus wrote:—"Verum in iis quoque Monocotyleis embryis, in quibus pars cotyledonaris a radiculari quam maxime distincta videretur, hæ partes vix iis dici possunt vicibus fungi, quæ in Dicotyleis embryis horum organorum propriæ sunt. Si igitur perfectissima etiam monocotylea embrya eum evolutionis gradum proxime tenere videntur, qui in imperfectioribus quibusdam Dicotyleis embryis cernitur, nonne veriùs est statuere, Monocotyledones potius eas formas esse, quæ propter imperfectam embryi formationem in inferiori quodam gradu constiterint, quam proprium quendam et Dicotyleis parallelum plantarum typum?"*

Origin of the Sheathing Petiole†.—A well-nigh universal feature of the leaves of endogens is their sheathing the stem in various degrees and not infrequently completely surrounding the latter, as occurs in palms, *Cyperaceæ*, &c. This is characteristic not only of endogens but also of many aquatic exogens, as of *Umbelliferæ*, *Ranunculaceæ*, &c. In an ordinary leaf of any exogen with a narrow and stiff petiole, there is either a single central cord or midrib, or else associated with it at least one pair of lateral cords which have arisen from points in the axial xylem-cylinder at some distance right and left of the central one. When a leaf has a sheathing base, however, there are generally present a larger number of lateral cords departing from points distributed more or less over the whole circumference and

* 'Theoria Systematis Plantarum,' per Jac. Geo. Agardh, 1858, p. lxxxiii.

We shall see below that Dutrochet came to a similar conclusion for the structure of the stem of endogens; and I shall give reasons for drawing a like inference from the study of the foliage.

† This section should follow later when treating of leaves, but I insert it here, as I wish to endeavour to account for the *coleorhiza* or sheath over the radicle of endogens. It also forms the *pileole* or first leaf-sheath of the plumule of grasses. See Van Tieghem's paper, "Observations anatomiques sur le Cotylédon des Graminées" (Ann. des Sci. Nat., Bot. 5 sér. tom. xv. 1872, p. 236, pls. 13, 14).

entering into the sheath. This *tendency* to "break up" the xylem-cylinder, so to say, is found in many exogens with sheathing leaves; as well as the production of central or medullary cords, which is particularly characteristic of *Umbelliferæ*, e. g. *Silaus pratensis* *. The structure of the fibro-vascular system of the nodes of stems of umbelliferous plants appears to be particularly significant; for sections through those of fennel †, carrot, &c., show an extraordinary amount of *confusion* in consequence of the departure of large numbers of cords for the leaf-sheath. If sections be made at the node of the aquatic stem of *Limnocharis Humboldtii*, or that of a flowering-stem of a Narcissus, a very similar confusion will be seen, certain cords isolating themselves, being destined in the latter plant for the spathe. In both cases it may be observed that the nodal confusion follows upon regularly arranged zones of fibro-vascular cords in the internode below.

A further fact follows. In consequence of so large a number of cords entering the petiole, the latter often reveals a structure, as seen in a cross section, identical in appearance with that of an endogenous stem. Such is well seen in *Angelica sylvestris*, *Caltha palustris*, *Ranunculus Lingua*, *Tommasinia Szowitsii*, and *Myriophyllum proserpinacoides* ‡. These tend to form a similar nodal plexus, while the cords of the petiole of the first-named plant form a very irregular circle surrounding a lysigenous lacuna.

The nodes of the above-mentioned exogens differ from those of endogens in retaining a central medulla, the confusion of the latter spreading all over a transverse section; but *Ranunculus Ficaria* advances a step further in this direction by occasionally sending a branch completely across the centre.

The above-described coincidences in structure between aquatic, umbelliferous, and other exogens and the sheathing bases of well nigh all endogens is, to say the least, highly significant §.

* "Ueber das centrale Gefässbündel-system einiger Umbelliferen," H. W. Reichart, SB. der mat.-naturwiss. Cl. Akad. der Wiss. Wien, xxi. 1856.

† De Bary does not appear to have seen the "confusion" I speak of; his figure (Vergl. Anat. Vegetationsorg. p. 241) giving no idea of what takes place at the nodes.

‡ The last two were obtained from the Botanic Gardens, Cambridge.

§ After the above paragraph was written I came across the following interesting passage in a letter from M. Mirbel to M. Deleuze, entitled "Considérations sur la manière d'étudier l'Histoire naturelle des Végétaux, servant

It may be added here that a plexus is found in the *Piperaceæ*, which also have medullary cords exactly as in *Commelyna*.

Origin of the Coleorhiza.—Now, not only is there a significance in the existence of sheathing petioles in aquatic exogens, which thus appear to point to the origin of this prevailing feature in endogens, but it may supply the interpretation of the coleorhiza in the embryo of Grasses, &c.; for the sheathing base of the leaf is not only characteristic of the fully developed condition, but would seem to be also applicable to the cotyledon; or, conversely, what commences in the embryo is continued up in the leaves. In Grasses, though the sheath of the true leaves is partially split, unlike that of the *Cyperaceæ*, yet the sheath of the first leaf, formed without a blade, is entire. This is what Mirbel called the "pileole." Now the broad basal attachment of the cotyledon (and perhaps the homologue of the sheath of the opposite cotyledon may be present as well) and the axial root are all fused together at the region of the insertion of the cotyledon (shield). The root differentiates itself below, separating away from the sheathing "coleorhiza," which it finally pierces at the basal end, and thus becomes endogenous. On the other hand, the plumule is generally included in a fold of the cotyledon or else in a sort of tube formed by the basal part of it, called by Mirbel the "coleoptile"; or, again, it may lie between the lobule and cotyledon, which are flat as in the oat, just as in a dicotyledon.

I would thus suggest, but purely hypothetically, that the coleorhiza of certain endogens, as of Grasses, may represent decurrent sheaths of the two cotyledons united; or, perhaps, of

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d'Introduction à un travail Anatomique, Physiologique et Botanique sur la Famille des Labiées" (pp. 8, 9):—"La plupart des caractères de l'anatomie comparée des végétaux se doivent tirer de certains rapports entre la disposition des vaisseaux nourriciers et la marche des développemens . . . . Ainsi, pour citer quelques exemples, les filets vasculaires disposés à la circonférence des jeunes tiges monocotylédones produisent nécessairement des feuilles engaînantes dont on reconnoît le type dans l'unité de cotylédon et dans la structure de cet organe; et, par une conséquence naturelle, l'unité de cotylédon est l'indice de l'engaînement des feuilles, et la forme de celles-ci révèle l'organisation des tiges. Ainsi, les tiges dicotylédones à feuilles engaînantes ont une écorce organisée à la manière des tiges monocotylédones [On peut voir facilement cette organisation dans la plupart des Ombellifères (*note*)], et ces dernières, lorsque leurs filets viennent à se réunir en couche, produisent, au lieu de feuilles engaînantes, des feuilles rétrécies à leur base."

one only completely investing the axis, terminating below and rounding itself off, over the radicular extremity of the embryo. Malpighi, I believe, first drew attention to it in Grasses, and Richard generalized upon it and thought all monocotyledons were "endorhizal." Mirbel, however, disputed this conclusion, and showed that many, as Palms, were exorhizal, and remarks concerning the coleorhiza, "Elle appartient visiblement au cotylédon" *. That it is a different thing from the ruptured cortex over all other roots is clear from the fact that the inner surface of the tube of the coleorhiza is perfectly regular and provided with what may be called an epithelium. Consequently it is not at all covered with that irregular condition of the cells which surrounds a secondary root which has dissolved and absorbed the cortex of the mother-root, through which it makes its way out. Mirbel, however, elsewhere seemed to regard the coleorhiza in this light, for he says:—"A bien considérer la coléorhiza, ce n'est autre chose qu'une écorce plus ou moins épaisse, qui se détache d'elle-même de chaque mamelon radiculaire" †.

Pseudo-coleorhiza of Tropæolum.—Some light may be perhaps thrown on the origin of the coleorhiza in endogens by the study of the embryo of *Tropæolum*. In this plant the cotyledons are very thick, a cross section of one being a semicircle; each has a groove down the middle. This indicates a conduplicate condition, which is seen to characterize the other leaves in the plumule. By making transverse sections from below upwards to the insertion of the cotyledons, the apex of the radicle with a pileorhiza of loose cells is observed quite free in the centre; while the thick sheath is made up of four "quadrants," united in pairs: that is to say, they represent downward and pointed prolongations of the two cotyledons, which are thus proved to be sagittate in form ‡. The four "quadrants" curve inwards below, nearly meeting over the tip of the radicle. These two pairs of downward prolongations form the sheath or "pseudo-coleorhiza."

Now, if we suppose them to be completely welded together, they would form a perfect coleorhiza over the end of the radicle. As a matter of fact they are so closely adpressed together that they are in places near the circumference practically coherent;

* "Examen de la Division des Végétaux en Endorhizes et Exorhizes," p. 427.

† 'Eléments de Botanique,' i. p. 81.

‡ *Cf.* Irmisch's figure—"*Tropæolum brachyceros*, Hook., und *tricolorum*, Sweet, nach ihrer Knollenbildung," Beitr. Vergl. Morph. Pfl., Taf. v. fig. 5.

the line of union being just indicated by the two delicate epithelioid layers.

I would also invite the reader's attention to the series of figures by Hegelmaier tracing the development of the embryo of *Tropæolum*. However, neither he nor Irmisch appear to have noticed the *four* divisions making the quadrants, which are so far distinct as to have a minute hole just over the tip of the radicle. Consequently Hegelmaier's figure * is evidently wrong. Sir John Lubbock rightly describes it †. Irmisch, however, shows the separation as seen in one direction ‡. Trécul § has described the basipetal origin of the lobes in *Tropæolum*, and explains how the peltate blade is formed by a basal outgrowth connecting the lowermost lobes, as occurs in *Nelumbium* and *Umbilicus*.

On examining the embryo of *Tropæolum majus* for the purpose of studying the nature of the pseudo-coleorhiza and comparing my observations with Irmisch's figures, there seemed to be several points which suggested an ancestral aquatic habit. Thus it will be seen ‖ that the first series of leaves formed on germination resemble those of *Nymphæa* and *Sagittaria*. The first is a subulate phyllode; the second has a linear spathulate blade; the third is subhastate, or somewhat suggestive of the adult leaf of *Menyanthes trifoliata*; the next being lobed and peltate ¶, *T. tricolor*. The orbicular leaf of *T. majus* suggests a similar origin to that of *Cabomba*, *Victoria*, *Nelumbium*, and *Hydrocotyle*; for in addition to the above features the stem of *Tropæolum* has regularly formed air-canals, as in true aquatic plants, and water-pores over the nerve-endings as in endogens. Lastly, *Tropæolum* has the marsh-plants *Limnanthes* and *Flœrkea* as its nearest allies. It will be seen hereafter, when comparing the germination in the *Nymphæaceæ* with that of *Sagittaria* and the *Aroideæ*, how that the sagittate form is pre-eminently characteristic of both an aquatic and an endogenous type of leaf.

* Vergl. Unters. Entw. dicot. Keime, Taf. ix. fig. 28.

† On Seedlings, i. p. 297.

‡ Beitr. Vergl. Morph. Pfl., Taf. v. figs. 17, 19.

§ "Sur la Formation des Feuilles," Ann. des Sci. Nat. 3 sér. xx. 1853, p. 235, pl. 23. figs. 85–91 (*Tropæolum*), pl. 25. figs. 153, 154 (*Nelumbium*).

‖ *Op. cit.* Taf. v. figs. 6–9.

¶ *Richardia* furnishes the intermediate condition of having sagittate-peltate leaves. These are aërial, but represent the aquatic form. Further observations on the *Aroideæ* will be made hereafter.

In concluding this part of the subject, I think the reader will agree with me that there is at least enough presumptive evidence to frame a theory that the monocotyledonous embryo has been derived from a dicotyledonous one by a suppression of one cotyledon; and that the cause of this suppression, as also, as we shall see, that of the primary root together with various degrees of degradation of the first leaves of the plumule, are due to the degenerating effect of the aquatic medium in which the ancestral endogens originally and primarily grew.

It should always be remembered that similar effects often follow in plants from various causes. Especially is this true in the case where organs show signs of degeneracy. Thus, the proembryonic state of the embryo may presumably be the result of water in the cases mentioned in this paper; as, *e.g.*, also in *Utricularia*. It, however, also occurs in the *Orchideæ*, which are not aquatic, to which I have elsewhere alluded *. It is found associated with other very degenerate conditions in many parasites; and it is also to be seen in saprophytes.

Evidences furnished by the Order Nymphæaceæ.—As the *Nymphæaceæ* are particularly remarkable for possessing many points of agreement in structure with endogens, it will be advisable to give somewhat in detail their peculiarities; as these will indicate in a collective manner the grounds for believing generally that endogens acquired their peculiar features through adaptations in a similar way to a watery medium.

Structural Resemblances between Nymphæaceæ and Endogens.—Much discussion was raised half a century ago upon the anatomical structures of *Nymphæaceæ*, as to whether they indicated an endogenous or exogenous position for this order. The final decision was based upon the dicotyledonous embryo, though it was recognized that they possessed several points of structure showing similarity with endogens. It did not, however, appear to have occurred to the observers that these very points of supposed affinity with endogens were simply similar results of adaptation to a watery medium. It is in the method of germination, the structure of the roots and rhizomes, and the development of the foliage where the resemblances will be found †.

* 'Origin of Floral Structures,' &c. p. 280.

† For a full discussion up to the date of the work, see 'Flora Indica,' by Drs. Hooker and Thomson, vol. i. p. 233 (1855).

Germination.—The embryo has two thick cotyledons, which remain within the seed-coat, and in the case of *Nelumbium* with the radicle as well *. The radicle of other genera of this order protrudes and develops a filiform primary root, or it is altogether arrested (Hooker and Thomson). The plumule ascends from between the cotyledons and gives off strictly opposite leaves in a plane at right angles to that of the cotyledons. Of these two, one has a vaginate petiole: this sheathing insertion of the leaf, as pointed out, is another feature eminently characteristic of aquatic plants whether they belong to exogens or endogens. The other leaf is reduced to a mere filiform or subulate petiole, and has no rootlets. It would seem that the arrest has not affected the cotyledons in this case; but it has influenced the first-formed leaves. In the cases of *Trapa natans* and *Ranunculus Ficaria*, &c., as already mentioned, it has reduced the two cotyledons to one only, or, still further, to the proembryonic state.

If the arrest of one cotyledon be due to an aquatic medium, it must take place while the embryo is developing within the embryo-sac. It has often been observed that while terrestrial endogenous plants have their seeds supplied with endosperm, those of endogenous aquatic plants and orchids are generally devoid of it. This may perhaps be correlated with a similar arrest having affected the embryo simultaneously. Thus "Herr F. Hegelmaier describes several abnormal embryos of *Nuphar luteum* in which the two cotyledons are more or less completely united into a sheath, split only on one side; but the two halves (corresponding to the two cotyledons) *have been developed very unequally*, one of them being usually several times as long as the other" †.

Although members of the *Nymphæaceæ* are usually regarded as dicotyledonous, we have here an important and independent witness to the gradual arrest of one cotyledon.

Arrest of primary Root.—The next peculiarity of germination is the tendency to, or complete arrest of the primary or axial

* "Études anatomiques et organogéniques sur la *Victoria regia*, et anatomie comparée du *Nelumbium*, du *Nuphar*, et de la *Victoria*," par M. A. Trécul. Ann. Sci. Nat., Bot. 4 sér. i. p. 145.

† Extract from Journ. Roy. Micr. Soc. 1892, p. 387; a notice of Herr Hegelmaier's paper, Jahr. Heft. Ver. vaterl. Naturk. Württemberg, 1890, p. 88. See Bot. Centralbl. xlix. (1892) p. 216.

root, with the subsequent development of adventitious roots in an ascending series, which is, of course, one of the most characteristic features of endogens. The stem thus assumes the form of an inverted cone. It is, however, by no means infrequent in aquatic exogens. Thus it is characteristic of *Nymphæaceæ*, and is very obvious in aquatic members of *Umbelliferæ*, such as *Œnanthe Phellandrium*. It occurs also in *Ceratophyllum demersum*.

Mirbel so long ago as 1810 discovered the cause of the arrest of the primary root in endogens. He says :—" J'ai cherché si la physiologie n'expliquoit pas ce phénomène. J'ai trouvé que la radicule correspond au cotylédon, qu'elle est nourrie par lui, et que son dépérissement a lieu à l'époque où le cotylédon se flétrit. J'ai trouvé en outre qu'il existe une relation bien manifeste entre les radicelles latérales et les nouvelles feuilles, en sorte que chaque feuille est en rapport avec une ou plusieurs radicelles." *

The arrest is not confined to the primary root in the *Nymphæaceæ*, but is continued into the first formed leaves, which thus pass through various stages of development, assuming in succession the following forms—linear, spathulate, sagittate, and hastate, before that the blade can arrive at the rounded form so characteristic of floating leaves of Water-lilies †, as also of *Limnanthemum*, *Hydrocharis*, &c.

I think, then, we can perceive with Mirbel the clue to the arrest of the primary or axial root of endogens. Since the development of roots depends upon the foliage, it is easy to see that when cotyledons are raised above ground and act as leaves, they can maintain the existence of the tap-root and enable it to grow until the foliage of the plumule is developed, and so carry on the same work, as in mustard or any other ordinary terrestrial exogen. Again, if the cotyledons remain below ground, the plumule *at once* develops its leaves perfectly, as in the oak, and its foliage can then nourish the tap-root instead of the cotyledons doing so.

In submerged aquatic plants, however, the first leaves are more or less rudimentary and arrested in character. Moreover, being under water their assimilating powers are greatly impeded.

* "Examen de la Division des Végétaux en Endorhizes et Exorhizes," Ann. Mus. d'Hist. Nat. 1810.

† See Trécul, Ann. Sci. Nat., Bot. 4 sér. i. pl. 12. fig. 1, and Barber, "On a change of Flowers to Tubers in *Nymphæa Lotus*," Ann. Bot. iv. p. 105, pl. v. fig. 13.

The consequence is that the primary root, which must be supplied with nourishment from the first formed leaves, suffers and finally perishes. This is true for aquatics of both classes; but, having become an hereditary feature, it is now characteristic of all endogens, whether they be terrestrial or aquatic in habit.

An illustration of the above may be seen in the germination of *Trapa natans*. One cotyledon is large and furnishes food-material to the primary root; but the other cotyledon is atrophied. The consequence is that one side of the hypocotyl and root is nourished more than the other. This causes a curvature towards the side on which the atrophied cotyledon lies, and induces the hypocotyl to develop a quantity of adventitious roots on one, the underside, only *. The main or tap-root soon appears to cease growing; so that the stem gradually assumes the well-known form of an inverted cone, characteristic of Indian corn and other endogens. A similar stem may be seen in aquatic *Umbelliferæ*.

The Root-cap or Pileorhiza.—M. Flahault, as far as I am aware, was the first to discover a marked difference in the development of the root-cap of endogens from that of exogens †, in that it is early separated and grows independently of the initial cells of the rest of the root, in the former; but it is not so in exogens.

M. Ph. van Tieghem has explained how this comes about ‡. He contrasts the two kinds of root-cap as follows:—"Chez les Dicotylédones et les Gymnospermes, c'est l'assise la plus externe de l'écorce qui subit une série de cloisonnements tangentiels, ordinairement centrifuges, et qui produit ainsi la zone corticale externe, dont l'assise la plus extérieure devient l'assise subéreuse, tandis que tout le reste, développé en direction centripète, forme la zone corticale interne.

"Chez les Monocotylédones et les Nymphéacées, l'assise corticale externe demeure indivise et devient l'assise pilifère; c'est la seconde assise qui subit le cloisonnement tangentiel centrifuge et produit la zone corticale externe, dont l'assise la plus extérieure devient l'assise subéreuse. . . . .

"Chez les Dicotylédones, à part les Nymphéacées, chez les Gymnospermes, chez les Lycopodes et les Isoètes, l'assise la plus

* See Organ. Végét. par. A. P. de Candolle, tom. ii. pl. 55.

† "Recherches sur l'Accroissement terminal de la Racine chez les Phanérogames," Ann. des Sci. Nat. 6 sér. vi. 1878.

‡ 'Traité de Botanique,' tom. i. p. 694 *seqq.*

interne de l'épiderme composé demeure, après l'exfoliation des autres, indéfiniment adhérente à l'écorce de la racine. . . . .

"Chez les Monocotylédones et les Nymphéacées, au contraire, l'épiderme s'exfolie tout entier, il devient tout entier la coiffe, et c'est l'assise externe de l'écorce, dont le contour est lisse, qui, une fois mise à nu, devient l'assise pilifère. Celle-ci est donc de nature corticale. Sous ce rapport ces plantes se comportent comme les Cryptogames vasculaires ordinaires."

With regard to the cause of the isolation of the root-cap in endogens, M. van Tieghem writes as follows *:—"Elles se détachent d'ordinaire, et cela de deux manières différentes. Tantôt la couche moyenne des membranes se gélifie, se dissout, les cellules des diverses files longitudinales s'isolent et la coiffe va s'émiettant pour ainsi dire à la périphérie dans un liquide visqueux. Chez les Monocotylédones, la gélification frappe jusqu'aux membranes externes de l'assise périphérique de l'écorce, ce qui fait que l'assise la plus interne de l'épiderme se détache commes les autres.

"Chez les Dicotylédones, elle s'arrête à la ligne de gradins qui sépare l'avant-dernière assise de la dernière; il en résulte que celle-ci ne se détache pas."

With regard to initial cells, M. van Tieghem observes that in *Nuphar luteum* and *Victoria regia* the cortex has only one, the central cylinder having two. In *Nymphæa*, both cortex and central cylinder have each but one initial cell †.

As parasitism and saprophytism, as well as an aquatic habit, are associated with an arrested embryo, it is interesting to find that the latter of the first two habits is also correlated with a like method of forming the root-cap. Prof. F. Oliver has described and figured the process in *Sarcodes sanguinea*, and mentions that it also occurs in *Monotropa* ‡.

"*Réseau de Soutien*."—There remains another feature which M. Ph. van Tieghem has noted, which appears to distinguish endogens from exogens, namely, what he calls "le Réseau de soutien de l'écorce de la racine" §. He describes a great

* 'Traité de Botanique,' i. p. 699.

† "Recherches comparatives sur l'Origine des Membres endogènes dans les Plantes vasculaires," par M. Ph. van Tieghem et M. Douliot. Ann. Sci. Nat. 7 sér. tom. viii. 1888, pl. 8. figs. 107–118.

‡ Ann. Bot. vol. iv. p. 309.

§ Ann. Sci. Nat. 7 sér. tom. vii. 1888, p. 344, &c.

number of genera of Dicotyledons and Gymnosperms; but unfortunately makes no mention of aquatic plants. As far as negative evidence goes, this may be due to the fact that he did not find it in any such plant, as he says was the case with all endogens. Now we know that the mechanical supportive tissues all become degraded or vanish in water-plants: so the absence of any "réseau de soutien" would be exactly what one would *à priori* expect; and if my contention be a true one, then a like absence of it from endogens can be accounted for. With regard to this apparatus, he says that it is of a precocious nature and lasts but a short time. It is differentiated at a short distance from the extremity of the root and exfoliates later with the cork, of which it forms a part. It occurs either upon the endoderm or is subepidermal, or else at some intermediate position in the cortex. It is formed by the cells being thickened in various patterns on the interior and radial walls.

Of course the significance of the above-mentioned observations lies in the fact that the *Nymphæaceæ* and other water-plants, &c., agreeing with endogens in so many points afford accumulative coincidences which collectively support a very high probability of the direct descent of existing endogens from aquatic exogens.

Dimensions of Vessels.—M. de Bary records another point in which *Nymphæaceæ* agree with endogens generally, namely, in the size of the vessels of the xylem in the roots. Describing those of endogens, he says:—" The xylem-bands, consisting of one or a few rows of elements, usually begin at the periphery with a short uninterrupted radial band of narrow tracheæ, which become gradually wider towards the inside. These are suddenly followed in the centripetal direction by one or a few very wide, reticulated or pitted vessels" *. A *rationale* of this fact may be that, being submerged plants (as are the *Nymphæaceæ*, and theoretically all endogens were so originally), larger vessels are required for the flow of a superabundance of water; just as large or several water-pores are often found at the ends of submerged leaves, as in *Callitriche*. With such, indeed, sometimes the tissue surrounding them actually breaks down, leaving a large hole instead, as occurs in *Myriophyllum*, &c.†

* Comp. Anat. &c. p. 357.

† An analogous interpretation may perhaps explain the occurrence of large vessels in the earliest formed wood of certain trees, as of the oak, ash, and *Castania vesca*. These trees are very late in putting on their foliage, conse-

The Foliage of Plumules compared.—The partial arrest of the primary leaves of the plumule in the *Nymphæaceæ* would seem to explain another contrast which Robert Brown first pointed out. In his observations upon *Cycadeæ* in his 'Prodromus,' he says:—"Plumulæ autem evolutio cum priori classe [*i. e.* Monocotyledons] magis convenit; in his omnibus enim, Gramineis Aroideisque exceptis, foliola primaria hujus organi semper abortiva et squamuliformia, vel meræ vaginæ sunt, dum in Dicotyledonibus omnibus folia perfecta evadunt" (p. 347). It is not clear why he excepts Grasses, for of this order he remarks:—"Plumula nuda vaginâ propriâ inclusa, foliolis primariis in folia perfecta mutatis" (p. 168). This "proper sheath" or "pileole" is simply the first leaf of the plumule itself. Of the *Aroideæ*, he notices with regard to the plumule:—"Plumula 2–3-phylla, foliolis margine involutis, exteriore cotyledoni opposito ejusdem rimæ marginibus amplexo, plus minus denudato! interiora opposita amplexante" (p. 334). It would seem, therefore, that in this respect *Aroideæ* would stand alone; Bentham and Hooker, it may be added, regard this order as a very isolated one.

The peculiar feature alluded to above of the primary leaf or leaves of the plumule being more or less arrested and scale- or sheath-like in endogens, receives its interpretation from an aquatic habit, as revealed by both *Nymphæaceæ* and *Sagittaria*.

Rhizome.—The peculiar anatomy of the rhizome of the *Nymphæaceæ* long ago caught the attention of botanists. Trécul, who devoted a year's study to *Nuphar luteum* * alone, came to the conclusion that "the structure of the stem is what prevails in the greater number of plants which have one cotyledon"; and from a further study of *Victoria regia* he expressed himself more positively, in that he was "confirmed in his opinion of the analogy of structure that exists between *Nymphæaceæ* and Monocotyledons."

Hooker and Thomson thus write:—"Commencing with our own analysis, we found that the rhizomes presented a central medullary mass, surrounded by a tolerably well-defined zone of

quently the sap, which must have been accumulating and rising as the temperature of the spring and early summer increased, now requires extra-sized vessels to carry it off; the later formed vessels, as, *e. g.*, of the oak, being quite diminutive in diameter.

* He describes it by the specific name *lutea*.

vascular bundles. They differ from Exogens in wanting liber, wood-wedges, and medullary rays, and in the confused arrangements of the vascular tissue; and from Endogens in the vascular zone surrounding a column of pith, in the arrangement of the vascular fascicles and in their composition. Our conclusion was, that the structure was quite reducible to a very low and deranged type of exogenous stem, such as might be expected to occur in an axis of which all the internodes are crowded into the smallest possible compass, and in a plant the habit and general arrangement of whose organs of support and nutrition differ so widely from that of ordinary exogens."*

Analogous forms of degradation occur elsewhere. Thus, a feature of what may be called *excessive degradation* has been noticed by botanists in several aquatic exogens and endogens, which renders their structure more or less identical. Thus M. Caspary has shown that *Aldrovanda vesiculosa* possesses the same structure as submerged endogens, especially of the tribe *Hydrilleæ* of *Hydrocharidaceæ*; as, *e.g.*, of *Elodea canadensis* †. Similarly, M. van Tieghem points out ‡ that *Utricularia* has certain resemblances to endogens as follows:—" L'axe du faisceau est occupé par un unique vaisseau étroit formé par une file de cellules superposées, à cloisons transverses fortement obliques et imperforées; ces cellules sont annelées, et leurs anneaux assez espacés alternent çà et là avec quelques tours de spire. Ce vaisseau appartient donc à la classe des vaisseaux imparfaits, sur lesquels M. Caspary a appelé, en 1862, l'attention spéciale des anatomistes, et qui, très-répandus chez les Monocotylédones, où M. Mohl les décrivait dans les Palmiers dès 1831, sont très-rares, au contraire, chez les Dicotylédones, où leur présence exclusive dans tous les organs n'a été signalée jusqu'à présent que dans l'*Aldrovanda*, le *Monotropa*, le *Nelumbium* et les *Nymphéacées* "§. M. van Tieghem adds in a note that he has been assured that *Gunnera*, a subaquatic plant, has also all the vessels of the petiole of this description. *Ceratophyllum* may be also compared with *Naias* in this respect.

* Fl. Ind. i. p. 236. Later writers appear to confirm these views. See De Bary's Comp. Anat. p. 252.

† Bull. de la Soc. bot. de Fr. 1858, p. 716; Bot. Zeit. 1859, 1862.

‡ "Anatomie de l'Utriculaire commune," Ann. des Sci. Nat. 5 sér. tom. x. 1869, p. 54.

§ Caspary, Monatsberichte der Berliner Akademie, Juillet 1862.

We thus see that the form of vessel described above is of a degraded or arrested type, and that on the one hand it is the result of water, or parasitism *, or saprophytism, and on the other it is characteristic of endogens generally, in which it has become an hereditary feature handed down from the time when the ancestors of existing endogens were aquatic †.

Origin of the Endogenous arrangement of Cords.—I would here venture to suggest a possible origin of the normally scattered arrangement of the fibro-vascular cords of endogenous stems. It will be seen from the figure given by De Bary of *Nelumbium* ‡, that the cords in a long internode are arranged in concentric circles. The five outer zones have been traced into leaves; some obscurity remains with regard to the inner circles. Now, when we remember that such simple herbaceous flowering-stems as those of *Anemone*, a Daffodil, and *Alocasia odora* § have their cords arranged in more than one zone, we begin to suspect that the zones of *Nelumbium* represent a first stage of disintegration of the compact zone or xylem-cylinder characteristic of exogens. This last is of course correlated with the requirements of strength; but this is not necessary in submerged or subterranean rhizomes. With these are correlated degradations (such as M. Costantin brought about by experiments). The order of retrogression, therefore, may be speculatively suggested to be as follows:—First, the cords of the xylem-cylinder remain isolated, no interfascicular cambium completing the zone; secondly, a second series of cords forming another zone belonging to the next sheathing-leaf, instead of uniting by intercalation with the first, forms a second circle, then a third would follow; and a fourth, and so on. The result would be a series of concentric circles, as seen in *Nelumbium*. Moreover, the leaf-traces consist of groups of five each (in *Nymphæa*), three to four groups being seen in a transverse section, the lateral cords reaching diametrically opposite points ‖. The last and easy

* Chatin figures many cases of imperfect vessels as occurring in parasites; only the individual cells are usually "barred" or subscalariform instead of annular. See, *e. g.*, those of *Hydnora*, pl. xcii. (*bis*), vol. ii. of his Anat. Comp. des Vég.

† De Bary's Comp. Anat. p. 369; *cf.* pp. 277 and 340.

‡ Comp. Anat. &c. fig. 112, p. 255.

§ "Recherches sur la Structure des Aroïdées," V. Tieghem, Ann. des Sci. Nat 5 sér. tom. vi. p. 95, 1866, pl. i. fig. 5.

‖ De Bary, Comp. Anat. &c. p. 252.

stage reached, when the internodes are arrested, may, perhaps, result from a simple dislocation of the cords, so that the regular series of circles is broken up, and the ordinary type of an endogenous stem results.

The Radiciferous Net.—Henfrey, who examined the rhizome of *Victoria regia*, brought out a point of some importance: in that he noticed the fibrous plexus, which is now called the "radiciferous net," so characteristic of many endogens, from which arise the cords to supply the adventitious roots. While, however, this net is distributed over the whole surface of the central cylinder * in endogens, so that roots can arise anywhere, in *Victoria* it is isolated at the bases of the leaves, so that roots *only* arise at those places. Hence the presence of the localized radiciferous nets shows another approximation to the endogenous type. After describing the characteristic features of Endogens and Exogens, Prof. Henfrey wrote:—"Applying these considerations to the structure presented by the stem of *Victoria*, we find unmistakable resemblance to the typical structure of Monocotyledons in the arrangement of its bundles, and the entire absence of that kind of regularity which produces an annular appearance of the fibro-vascular structure in a cross section; the great number and the isolation of the bundles, and the absence of a central medullary region, are especially monocotyledonous; and the relative position of the bundles in their course is closely in agreement. The chief difference consists in the collection of the bundles together into a kind of cord, where they run out from the central region into the petiole †—which arises from the comparatively narrow base of the leaf at its origin in the *punctum vegetationis*,—and in the existence of numerous bundles connected with the roots running up and down and around the stem in the region immediately within the rind. The former of these points indicates an agreement with the Dicotyledonous type: the latter departs less from the Monocotyledonous type than from the Dicotyledonous."

In *Nelumbium codophyllum* M. Trécul noticed a complete zone of vessels, their axes often horizontal, surrounding a medulla.

* "Origine et Insertion des Racines Adventives," L. Mangin, Ann. des Sci. Nat. 6 sér. xiv. 1882, p. 216; *cf.* pl. 11. figs. 21, 22.

† "On the Anatomy of *Victoria regia*," part ii., Phil. Trans. 1860, p. 479.

From this zone arises the adventitious roots; while he figures the attachment of the roots to this zone in *Nuphar luteum* as a funnel-shaped process consisting of branching tracheides, not at all unlike what takes place in endogens; indeed, M. Trécul observes with regard to the adventitious roots:—"La structure et l'accroissement sont aussi ceux des racines des Monocotylédones." . . . "Au point d'origine de ces racines, les faisceaux du centre sont unis entre eux par un cercle vasculaire, qui relie le système des vaisseaux de toutes les racines adventives qui naissent du même plan transversal"*.

Other Exogenous Stems with scattered Cords.—The *Nymphæaceæ*, however, are by no means the only exogenous group with scattered medullary bundles. There are doubtless other causes besides water which may bring about a disarrangement of the cords; one of these appears to be a climbing habit. The relaxation of the effort required for self-support results in an alteration of the characters of the xylem zone, in that the wood fibres become less lignified and the vessels larger and more numerous. Accompanied with these features is a different arrangement and often origin of fibro-vascular cords. The *Cucurbitaceæ* and *Piperaceæ*, for example, both illustrate the occurrence of medullary bundles; while that of *Peperomia* is particularly interesting from the present point of view, as it is practically identical with that of *Commelina* †.

We have already seen some analogous degradations between the embryos of parasites and of aquatic plants; the former also furnish others in the structure of the stem. Thus species of *Viscum* have an irregular circle of very unequal-sized cords. *Myzodendron* has two concentric circles of completely isolated ones. Lastly, *Cynomorium coccineum* and *Helosis guyanensis* have them scattered through the ground-tissue exactly like any endogenous stem ‡.

There are, of course, many other instances of medullary cords in exogens, both in the stems and petioles, as in several of the

* Ann. Sci. Nat., Bot. 4 sér. i. p. 165, pl. 14. fig. 13, "Recherches sur la structure et le développement du *Nuphar lutea*;" and Ann. des Sci. Nat. 3 sér. tom. iv. 1845, p. 286, pl. 10. fig. 4, pl. 11. fig. 11.

† See descriptions and figures in De Bary's Comp. An. of Phan. and Ferns, pp. 248 and 269.

‡ For figures, see Chatin, Anat. Comp. des Vég. vol. ii. pls. xciii. and xcvii.

Umbelliferæ *, in *Amaranthus*, *Phytolacca dioica*, species of *Actæa*, *Thalictrum* †, herbaceous genera of *Berberidaceæ*, in some *Cycadeæ*, &c.

One is not prepared to suggest the causes in each case, for not enough is known of the habitats and climatal conditions, not only of existing species, but of their ancestors.

All I would maintain is, that as far as the typical endogenous stem is concerned, it would seem to be probable, from a study of the *Nymphæaceæ* above all others, to have been due to the particular degenerating effect of a watery habitat.

As the monocotyledonous embryo has been considered by several botanists as of a thalloid or less differentiated type than the dicotyledonous, one which I would regard as being more degraded, so the stem is looked upon, not as a differential form on a par with that of exogens, but as a degradation from it. Thus Dutrochet wrote :—"La théorie que je viens d'exposer placę les monocotylédons au dessous des dicotylédons dans les degrés de la perfection organique. Les monocotylédons offrent véritablement un arrêt de formation; ils se sont arrêtés à l'organisation gemmaire, qui n'est que transitoire chez les dicotylédons, lesquels ont atteint un degré plus élevé de l'organisation végétale" ‡.

This arrest and, so to say, degenerated disorganization I would attribute primarily to an aquatic medium.

Foliage of VICTORIA REGIA *and* SAGITTARIA SAGITTÆFOLIA *compared.*—Although the typical character of submerged leaves of exogens is to be dissected with filiform segments and that of endogens to be ribbon-like, the first leaves of some of the *Nymphæaceæ* when germinating bear a remarkably close resemblance to the forms of the leaves of *Sagittaria* which these latter assume according to the depth of the water. Thus, in a germinating plant of *Victoria regia* the first leaf is altogether deprived of a limb, being reduced to a petiole with a median nerve; the second has a lanceolate limb, the third being hastate, the fourth sagittate-peltate. The subsequent perfect leaves are orbicular-peltate.

Similarly with *Sagittaria sagittæfolia* there are ribbon-like phyllodes in deep water, the plant when bearing them alone being known as the form *Vallisneriifolia*. Then follow consecu-

* De Bary's Comp. Anat. &c. p. 253.

† Ibid. for details of the structure of the bundles.

‡ "Observations sur la forme et la structure primitives des embryons végétaux," p. 165. Nouv. Ann. du Mus. d'Hist. Nat. tom. iv. 1835.

tively, as the surface of the water is approached, the spathulate and hastate forms. Finally, there occurs the sagittate type, but this is now aërial. The sagittate-peltate is attained by *Richardia*, but the orbicular form is not reached in these genera. M. Costantin figures an individual plant of *Sagittaria* which bore, after a small number of submerged leaves, some floating oblong-cordate leaves; but the truly circular form is, however, characteristic of the endogen *Hydrocharis* and imitates that of *Limnanthemum*, *Nuphar*, *Caltha*, &c. among exogens. Conversely, the ribbon-form so characteristic of endogens is imitated by those of *Lobelia Dortmanni*, *Limosella aquatica*, *Littorella lacustris*, *Hippuris vulgaris*, and *Callitriche* in exogens.

The Forms of Aquatic Leaves due to Self-adaptation to the Environment.—That all the forms of leaves, submerged or floating, represent so many adaptations to their environment, is particularly well seen in the formation of the linear-ribbon-like form of endogens and the dissected type of exogens; for these can be produced at will. Thus M. Costantin has shown that if a leaf of *Sagittaria* which has begun to form a sagittate blade near the surface be suddenly plunged into deep water, the form is instantly changed; the blade now develops an elongated point, attempting, in fact, to return to the deep-water ribbon-form. It ultimately assumes an elongated-hastate shape. I have, however, a specimen in which all the three points appear to have been affected; and although the blade is sagittate, the points have grown out into elongated and narrow prolongations.

As another adaptation, I have found grasses growing completely submerged, the leaves of which had assumed the ribbon-form, while the anatomy was the same as that of ordinary and normal ribbon-like types.

Similarly with *Ranunculus heterophyllus*, leaves can often be procured, one half being of the floating type, the other half of the leaf being dissected; and if an aërial terrestrial plant with dissected leaves be plunged into water, all the *adult* leaves at once perish, new ones in adaptation to water soon taking their place; but all *half-developed* leaves continue to grow, their new growths, however, conforming to the watery medium.

That the floating leaves also assumed forms in adaptation to their conditions is presumable from the fact that similar forms are found in widely different plants, as mentioned above; and such, therefore, cannot be regarded as any indication of affinity:

as, *e. g.*, between the endogenous *Hydrocharis* and the exogenous *Limnanthemum*.

We are indebted to Mr. W. P. Hiern for demonstrating the truth of the above inference; for he has shown by mathematical calculations that the best form of the margin of floating leaves for resisting the strains due to running water is circular, or at least the several portions of the margin would be circular arcs; showing that nature had adopted what was most serviceable in this respect in such leaves as *Ranunculus heterophyllus*, *Nymphæaceæ*, *Limnanthemum*, and *Hydrocharis*.

Mr. Hiern concludes his paper with the following remarks:—"It is a tenable hypothesis, and by no means improbable, that during much or most of the time when actual growth is taking place and when the velocity of the current is subject to many and various vicissitudes, the plant has the power of adapting its growing efforts to the circumstances just necessary for its development"*.

EMBRYONIC CHARACTER OF THE LEAVES OF ENDOGENS.—That the prevailing ribbon-like form of submerged leaves of endogens is of a more "embryonic" character than the dissected type of submerged leaves of exogens, would seem to be shown by those of *Hippuris* and *Callitriche*. The leaves of those plants, in fact, resemble cotyledons. *Callitriche* has three ribs radiating from the base, while *Hippuris* has a still simpler leaf. As long as a stem develops its foliage under water, the leaves of these plants at once assume the delicate elongated form so characteristic of endogens; whereas in *Victoria* the submerged leaves (like those of *Ranunculus heterophyllus*) are adopted from a more adult stage of growth. Consequently the first leaf in the *Nymphæaceæ* is not flattened out and ribbon-like, but more resembles a channelled petiole without a lamina.

From the above considerations one arrives at the conclusion that those terrestrial endogens which still retain a linear form (*e. g.* Grasses) or ensiform (*Iris*) or other similar type of leaf, or rather phyllode, may be regarded as representing the ancestral submerged ribbon-like form; and those endogens with distinct blades of a lanceolate shape (*Convallaria*, *Epipactis*, *Paris*, &c.) or cordate (*Maianthemum*) represent the floating types of existing aquatic endogens; while the sagittate form, so characteristic of

* "A Theory of the Forms of Floating Leaves in certain Plants," Proc. Camb. Phil. Soc. pt. xiii., 1872.

the *Aroideæ*, has primarily arisen, like the same forms in the *Nymphæaceæ* and *Sagittaria*, from an aquatic habit.

ORIGIN OF THE ALOËIDAL TYPE OF LEAF.—A particular example of leaf may be here mentioned, namely that of *Stratiotes aloides*. This plant has leaves of the ribbon-form provided with what I would call "dog-tooth" cells at intervals along the margins. They have nothing in common with the teeth of an aërial serrated leaf, as that of a rose, or a dentate aërial leaf. Such projecting cells are not uncommon on submerged leaves, and may even take the form of subulate bristles, as occurs on the tips of the segments of *Ranunculus heterophyllus* and in the "traps" of *Utricularia*.

Comparing the foliage of *Stratiotes* with terrestrial forms, we seem to see it repeated in *Pandanus*, the leaf of which has parallel venation with rectangular cross-bars. It is also provided with very similar teeth. We may, perhaps, advance a step further and recognize the same submerged type of leaf as the origin of that of Aloes, which have supplied the specific name to *Stratiotes*, although these plants have now acquired an exactly opposite habit of life to an aquatic.

THE "JUNCEOUS" TYPE.—There is yet another type of leaf which may be briefly mentioned here which is more or less characteristic of certain orders of endogens, but of certain aquatic plants only of exogenous orders. This is the well-known junceous type, in which the leaf is not infrequently fistular and septate. This occurs in species of *Juncus* which furnish the name, and may be also seen in *Œnanthe fistulosa* and *Crantzia lineata* and many other plants. As it is associated with an aquatic habit, the inference is justifiable from all analogy that it is the watery environment which has brought it about.

VENATION.—It will now be desirable to give a brief series of forms to show, on the one hand, how terrestrial endogens have arisen from aquatic endogens; and, on the other, how these latter arose from aquatic exogens. A study of the venation will illustrate this process remarkably well.

In comparing the venation of the leaves of terrestrial endogens with that of aquatic endogens, and again with that of some forms of aquatic exogens, we at once see very close resemblances; so that a series can be readily made from extreme simplicity, as of *Hippuris*, *Zostera*, or *Potamogeton gramineum*, to *Tamus*

communis and *Arum triphyllum*, which have adopted, *e. g.*, the same process of inarching of the veins * near the margin as is so characteristic of exogens, together with a perfect system of reticulations between the stronger ribs.

Some such series may be formed of the following:—Commencing with submerged leaves, as *Hippuris*, *Zostera marina*, and *Potamogeton gramineum*, these have from one to three or more delicate ribs about equal in strength, running parallel to one another from end to end with no cross-bars †. The aërial leaves of *Sparganium ramosum* are in this condition, while a terrestrial form with greatly strengthened ribs is *Narthecium ossifragum*. In *Potamogeton crispum* the leaf is reduced in length and broader; in *Sparganium natans* the leaf is long and narrow; but in both the lateral ribs are now joined by well defined cross-bars, at an angle of about 45° in the former and at right angles in the latter. The outer series in the former are connected with a delicate marginal rib. A much broader leaf, framed on the same plan, is that of *Ouvirandra fenestralis*, the ribs being equal in strength and united by cross-bars at right angles to them. An exactly similar venation appears to have characterized species of *Naiadita* occurring in the Liassic strata near Bristol; while *Pandanus*, of living trees, and *Goodyera repens*, of herbs, have a similar venation.

Passing on to floating leaves, *Potamogeton natans* furnishes the next type of venation. It has pointed-elliptical blades with curvilinear ribs; but instead of having cross-bars, the interstices are now filled in with reticulations. The leaves of *Lilium auratum* represent this type among land-plants of endogens. We may, perhaps, see an important difference at this point, namely, that the rule may, perhaps, be found that reticulations do not appear unless the leaf is exposed to air and light. On the other hand, the quadrangular spaces between the ribs and cross-bars are the result of being submerged. This appears to be proved by the leaves of certain exogens which are now aquatic in habit, in which the *reverse* process may be seen to be attempted. Thus, of

* For convenience of distinction I call the longitudinal cords "ribs" and the lateral branchings "veins," forming "cross-bars" and "reticulations."

† *Zostera* furnishes a peculiar form of cross-bar; for it does not merely unite two adjacent ribs, but runs between the two surfaces of the leaf, horizontally or obliquely, across several ribs, always terminating abruptly in the side of a rib. It does not consist of "liber-fibres," of which the ribs are solely composed. It is difficult to make out from dried specimens the nature of these "rods." They fracture transversely easily. They require further investigation.

Ranunculus Flammula and *R. Lingua* the long linear-lanceolate aërial leaves have already acquired an approximation to the characters of the submerged leaves of endogens; *i. e.* so far as is shown by the general equality of the strength of the ribs, by the endeavour to place them parallel to one another, though they still issue from the midrib, and by cross-bars now assuming a regularly parallel position, all inclining at about 45° to the ribs. Similarly in *Polygonum amphibium* the hairy terrestrial leaves are elongated, with a comparatively strong midrib; the numerous lateral veins are pinnately arranged, with inarching margins. The blade of the hairless * floating form is much shorter, with a weaker midrib, but the lateral veins are similar. The venation of the thin submerged leaf is quite different. It has the midrib reduced to the same size as the lateral ones, which now run as parallel as possible, starting at a very acute angle from near the base. The marginal inarching is becoming lost.

Of submerged linear leaves of exogens, *Lobelia Dortmanni* has a ribbon-like leaf, which in form exactly resembles a submerged endogenous leaf; but an inspection of the venation shows at once that it is an adaptation from a reticulated exogenous type. As in the preceding, the ribs are as parallel as possible, while irregular reticulations are retained.

A still further degradation is seen in *Limosella aquatica*. The leaves of this plant have long petioles with spathulate, linear, or bluntly lanceolate blades. In these the ribs run parallel in the petiole and are curved in the blade, without cross-bars.

Callitriche and *Hippuris*, as already stated, appear to have reverted to an almost cotyledonary type of leaf, assuming the rudimentary character of venation as usually seen in the cotyledons of exogens.

The leaves of terrestrial endogens illustrate the retention of the ancestral aquatic characters of a parallel or curvinerved venation more or less perfectly; but they have superadded to this other features—as reticulations, stomata, &c.—which are adaptations to an aërial existence.

On the other hand, aquatic exogens, when their leaves become submerged, retain more or less the aërial types of venation, but adapt their structure to an aquatic existence; thus rendering them more or less comparable with existing endogenous leaves.

* The almost universally hairless condition of endogens is another general coincidence with the glabrous state of true water-plants.

It will not be amiss to give a few more illustrations. Thus *Epipactis latifolia*, *Cypripedium Calceolus*, and *Goodyera repens* have leaves with many parallel curvilinear ribs united either by straight or wavy cross-bars with no other reticulations, thus closely resembling such aquatic types as *Potamogeton*. *Listera ovata* illustrates a more advanced condition in that, while retaining the curvilinear ribs, the cross-bars are mainly perceptible only on the margin, the rest of the blade being covered with minute ramifications. In this plant the cells of the epidermis have the deeply waved margins so common in exogens. Conversely, it may be mentioned here that *Hippuris*, with its elongated ribbon-like submerged foliage, has elongated rectangular cells like the prevailing ones of the epidermis of most endogens. Again, *Alisma Plantago*, var. *lanceolatum*, and *A. Plantago*, proper, have equal-sized longitudinal ribs, but they are connected by cross-bars at an angle of 45°; while the *latter* has the parallelograms filled with reticulations.

Of purely terrestrial forms, *Paris quadrifolia* and *Tamus communis* have retained the curvilinear ribs, as of *Potamogeton natans*, and the interstices are filled in with reticulations, as in the last-named plant; but the inarching process on the margin is becoming pronounced, especially in *Tamus*.

The *Aroideæ* furnish several varieties. Many are aquatic or subaquatic still; but others are terrestrial. Commencing with *Acorus Calamus*, we seem to see an aërial form of the ribbon-like submerged leaf of *Sagittaria* and *Vallisneria*; *Arum maculatum* produces small elliptical leaves at first, recalling the form of the floating leaves of *Potamogeton natans*, or an occasional one of *Sagittaria sagittæfolia*; while the sagittate form, which might almost be called typical of the *Aroideæ*, is paralleled with the immature leaves of the *Nymphæaceæ*, and the perfect ones of *Sagittaria*. *Richardia* sometimes attains to the peltate-sagittate form of *Victoria*.

As a very advanced type, *Arum triphyllum* may be mentioned. This agrees very closely with exogens, in that it is not only divided into three very distinct portions, if they may not be called leaflets, but it has a most perfect degree of the marginal inarching process, and is covered with reticulations.

Another advanced condition is seen in the leaf of *Dieffenbachia seguinum*. This has a strong midrib and innumerable veins given off in a pinnate manner, just as described above in the terrestrial

and floating forms of *Polygonum amphibium*, which run to the margin, as is usual in aquatic leaves, without any inarching. Reticulations occur abundantly between the veins. The origin of this type of pinnately-nerved leaves seems to be as follows:—Commencing with that of *Ouvirandra*, there are several ribs united by cross-bars. The same arrangement occurs in the lily of the valley; but in other cases, as in *Smilax*, the ribs become reduced to three, the cross-bars becoming longer and closer together. Now, if we suppose the lateral ribs to be arrested, the pinnated venation of *Dieffenbachia* results.

That something like this has taken place seems probable from the converse process, which occurs in the leaves of *Polygonum amphibium*; for while, as stated, the aërial and floating leaves have feather-like veins, the submerged ones have nearly parallel and longitudinal ribs, many of the lateral veins now assuming the character of cross-bars.

Cause of Marginal Weakness in the Leaves of Endogens.—The above brief epitome of the leaf-structure of endogens will, perhaps, help one to explain another feature not infrequently observable in endogens. The inarching process at the margins of the leaves of exogens, often coupled with a marginal rib, affords great strength against laceration by the wind. In endogens, however, not only is the inarching usually absent, but the ribs and veins are comparatively weaker, especially if they be of aquatic and subaquatic plants. The facility of tearing, which may be seen in the submerged leaves of *Nymphæa*, in those of bananas, in palm-leaves, and blades of wheat, &c., may be thus traceable to an enfeebled structure primarily due to an aquatic habit.

Origin of Fenestration.—Yet another feature may receive a similar interpretation. One effect of a watery medium is to arrest the formation of the cellular tissue between the ribs and veins. Hence arises the dissected type of submerged leaves of many exogens, and the fenestrated condition of species of *Potamogeton* and, above all, of *Ouvirandra fenestralis*.

Now, if my contention be true that aquatic plants are thus descended from terrestrial, and can subsequently recover their lost habits, by becoming terrestrial again, it would be in accordance with all analogy that while doing so they would retain aquatic features associated with aërial and terrestrial adaptations.

Thus, just as *Ranunculus heterophyllus* readapts its dissected leaves for an aërial existence without refilling up the interstices with parenchyma, as in the floating leaves, so analogous conditions may occur in endogens. In submerged leaves of endogens, since the ribs run from end to end, the dissected type is not possible; but fenestration represents it. As this has now become an hereditary character in *Ouvirandra*, it is not surprising to find a similar feature retained in some terrestrial endogenous plants at the present day, as in the Aroids *Tornelia*, *Monstera*, &c., which are presumably descended from aquatic ancestors; as this feature is not due to "tearing" as in banana-leaves, but to an arrest of development of the cellular parenchyma.

If such plants are grown in a luxurious soil, the number of cavities decrease or cease altogether, showing that they are due to a deficiency of nutriment, but the "habit" of producing them has become hereditary *.

Air-canals.—These occur in all water-plants, are of symmetrical construction, often with peculiar diaphragms, and are found in exogens and endogens alike. Consequently it is justifiable to assume them to be adaptational to an aquatic existence. When, however, water-plants become terrestrial, they may be retained, as is the case with *Ranunculus Ficaria*, *Caltha palustris*, and *Rhizophora*. Similarly they are found in *Pandanus*, *Strelitzia*, *Musa*, &c., which no longer grow with their petioles and stems submerged; consequently, the inference is that those plants have descended from truly aquatic ancestors.

Water-glands.—There is yet another feature which separates Dicotyledons from Monocotyledons, which Dr. Volkens observed, namely, that in the former "there is usually present a well-developed water-gland, possessing several layers of 'epithem' tissue interposed between the tracheides, into which the spiral vessels pass, and the epidermis. In Monocotyledons the tracheides frequently end directly beneath the epidermis, or are at most separated from it by one or two layers of cells only, which never, so far as could be observed, show that marked dis-

* It may be remarked that accidental checks to growth by frost often produce them in the leaves of expanding buds of trees; so that when the leaves become adult they appear perforated and subpinnate, when they would naturally be entire.

tinction from the surrounding tissue as do the cells of the epitheca proper" *.

The significance of these differences resides in the fact that the monocotyledonous type is characteristic of submerged leaves of some exogenous plants. Thus, M. de Bary describes the leaf of *Callitriche verna* as having a large pore lying over the end of the vascular bundle †. "In *C. autumnalis* there lie on the young leaf a group of 3–8 open stomata; in the mature leaf the guard-cells of these break down, so that there remains a wide hole in the epidermis." I have examined these leaves, and others, myself, and find that it is similarly the case in *Myriophyllum*; and when this plant is aërial in habit there is the same destruction of the apical cells. It is not so, however, in *Callitriche*. In the submerged and much-elongated leaf the apex is crescent-shape with the concave edge outwards. This disappears in the aërial form, the leaf being rounded off; intermediate stages occur in subaquatic leaves.

Now this more or less arrested condition of the so-called epithem tissue, in consequence of which the tracheides are more closely in contact with the pore itself, as seen in these and other aquatic exogens, appears to be the permanent condition in endogens; and, taken with so many other features, tends to support the contention that they are all descended from aquatic forms of exogens.

Reproductive Organs of Endogens.—Though the influences of an aquatic medium powerfully affect the vegetative organs of plants, the reproductive organs are not infrequently considerably modified as well, especially by being degraded. Flowers, however, may have an antagonistic power under certain conditions, so that degeneracy due to the habitat is not universal. In my work 'On the Origin of Floral Structures' I endeavoured to show that conspicuousness in the floral organs was a direct result of the local stimulations set up by insects ‡; so that if they visit the flowers of aquatic plants, this stimulus may presumably tend to equalize, if not surpass, the degrading influ-

* "On the Physiological Significance of Water-Glands and Nectaries," by W. Gardiner; Proc. Camb. Phil. Soc. 1883, p. 35, where the literature of the subject is given.

† Comp. Anat. of Ph. and Ferns, p. 53.

‡ Conspicuousness having arisen under their influences, just as it is greatly enhanced by the artificial crossing by florists.

ences of an aquatic medium. It is only by taking a large and comparative survey of endogens that one can come to any general conclusion on the subject.

First, then, let us observe that of the truly aquatic orders, while some, such as *Hydrocharideæ*, *Butomeæ*, and *Alismaceæ*, have conspicuous flowers, a large number of genera included in *Juncagineæ*, *Potameæ*, *Naiadeæ*, *Typhaceæ*, *Junceæ*, *Cyperaceæ*, *Restiaceæ*, &c. are very greatly degraded.

Hence, the evidence from coincidences is accumulative, while comparative anatomy justifies the conclusion that there has been a distinct "cause and effect" in the reduction of the floral structures.

In looking for general peculiarities among the inflorescences of endogens, the spadix or dense, mostly unisexual spike is observable. Thus, *e. g.*, it occurs in *Aroideæ*, *Potamogeton*, *Typhaceæ*, *Pandanus*, *Cyclantheæ*, *Aspidistreæ*, &c. In those cases the perianth is generally greatly reduced or wanting, as in *Arum maculatum*, while the sexes may be separated as in that species.

Turning to *Alismaceæ*, &c., with their more highly developed perianth, we seem to see the origin of some of the spicate forms; for *Alisma Plantago*, *Sagittaria sagittæfolia*, &c. supply whorls. *Juncaginaceæ*, to which *Aroideæ* are allied, have racemose spirally arranged flowers. Supposing these to be reduced to compact spikes by the arrest of the pedicels, we arive at the spadix, the perianth becoming arrested, in consequence of the flowers being densely compacted. This, it will be remembered, is a very general result elsewhere, when flowers are very crowded, as far as the calyx is concerned. Thus it is more or less aborted in *Umbelliferæ* and all the *Gamopetalæ* with inferior ovaries, as well as *Rhododendron*, *Syringa*, &c.

The fact that *Sagittaria* has male flowers above and whorls of females below, is suggestive of the origin of a similar arrangement as occurs in *Arum maculatum*.

The arrest of pedicels and the conversion of panicles to spikes with various degrees of reduction of the perianth to bristles and hairs, as occurs in *Typhaceæ* and *Cyperaceæ*, &c., or to scales (lodicules*) in *Gramineæ*, are gradations correlated on the one

* With regard to any use these diminutive organs may have, I would suggest that they are little reservoirs of water. They always contain it, and sometimes have bladdery aqueous cells on their surface.

hand with, and may be partly traceable to an aquatic medium, partly to the absence of insect visitors, and partly to the crowding of the flowers.

Lastly, a feature correlated with the whorled inflorescence of *Sagittaria*, &c., is the fact that in many cases the dense mass of flowers on spadices is not arranged spirally, but in alternate whorls. This is the case, *e. g.*, in *Potamogeton natans*, the whorls being in threes, and fourteens in *Acorus Calamus* *.

Another peculiarity of several genera of endogens resides in the quaternary arrangement of the floral organs. Thus, it is found in *Tetroncium*, *Potamogeton*, *Caulinia*, *Naias*, *Carludovica*, *Gymnostachys*, *Aspidistra*, &c. The question arises, how has the number "four" arisen? In the work mentioned I offered the explanation of quaternary flowers in exogens as generally resulting from an opposite and decussate condition of the leaves; and I think the same cause will apply to endogens, though the leaves of endogens are never, as far as I know, opposite and decussate, *excepting the first pair*, as M. Ph. van Tieghem has shown to be the case in *Asparagus*.

Before I return to the preceding suggestion, it will be as well to show why other resources for a quaternary type must be rejected. The first is "symmetrical reduction"†. Though fives are typical of, say, Elder-flowers, sixes and fours may be often met with as the results of symmetrical increase and reduction respectively. Similarly, sevens and fives are to be found in *Lythrum Salicaria*, in which sixes are usual or normal. Now in endogens threes are normal. Therefore fours might be expected to be found occasionally by symmetrical increase; but there is no ground for supposing fours could thus become established in so many genera of different orders.

Turning to phyllotaxis, the same or "primary" ‡ series, represented by the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, &c., applies to endogens as well as to exogens, the leaves being usually either distichous or tristichous; but fours are not obtainable as cycles from any one in this series. If the secondary series $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{7}$, &c. ever occurred in endogens, then "fours" might have resulted, just as "threes"

* Similar differences occur among the cones of *Cycadeæ*.

† "Note on the Causes of the Numerical Increase of Parts of Plants." Journ. Linn. Soc. 1877.

‡ "On Variations in the Phyllotaxis of *Helianthus tuberosus*." Trans. Linn. Soc. vol. xxvi. p. 647 (1868).

occur occasionally in exogens, *e. g. Berberis* and *Rumex*; for every portion of the spiral of the latter series which, when projected upon a plane, forms a circle (excepting the case of $\frac{1}{3}$) contains *four* leaves, just as a similar circle of the former series contains *three*. I am not aware, however, of the secondary series occurring in endogens at all; the leaves of *Potamogeton, Cyclanthus*, &c., *e. g.*, being distichous, or $\frac{1}{2}$.

If, however, endogens be derivable from an early stock with a dicotyledonous embryo, then it would not be very surprising to find occasional reversion to what prevails in exogens, especially in the most elementary, simple, or degraded parts.

Now, M. Ph. van Tieghem has found, as explained above *, that when *Asparagus* germinates there is actually a pair of leaves developed at right angles to the plane passing through the one cotyledon and the first leaf, which now takes a position opposite to it. These two pairs subsequently give rise to the $\frac{2}{5}$ arrangement, as I have elsewhere explained. Hence fours, as in the flowers of *Potamogeton*, seem *probably* referable to a reversion to a very primitive condition of an opposite and decussate arrangement, now only to be seen elsewhere in the germinating plantlet. This, at least, is the only interpretation I can suggest; for although M. Ph. van Tieghem found it to be as above described in *Asparagus*, one would hardly expect that this is an isolated condition of things in endogens. Indeed, a similar feature appears to be observable in *Tamus*.

Conclusion.—That endogens and exogens have had some common origin is, in the first place, obvious from the numerous points of agreement between their organs and tissues generally, as shown, *e. g.*, in the structure of their flowers and anatomy of their roots, &c.; but the object of the present paper was to prove, if possible, that there was a more special connection between endogens and an aquatic habit.

The coincidences in points of structure between endogens generally and aquatic, subaquatic, as well as such exogens as may reasonably be supposed to have had an aquatic ancestry, will have been now seen to be perhaps more numerous than the points of agreement with exogens generally. Though it may be impossible to verify all the inferences by experiment, yet nature supplies us with several "experimental verifications" in the

* *Supra*, p. 492.

alterations of structure in amphibious plants, according as they live in water or on land. I think these coincidences are sufficient to prove that endogens have, in the first place, descended from very early types of exogens which preceded them; and that, secondly, the more immediate cause of their origin was an aquatic habit of life assumed by certain primitive exogenous plants.

To state the process of adaptation in as few words as possible, one might say that it was effected by means of the joint action of the external influences or forces of the environment and the internal responsive power of living protoplasm; so that when a terrestrial and aërial plant is grown in water, or a water-plant is transferred to land, the direct action of the new environment compels the plant (provided it can survive the change) to so alter its structure, *i. e.* of its histological elements—which in turn, of course, cause changes in the morphological—that the plant now becomes *at once* adapted to the new medium. The change from land to water brings on what may be therefore called "adaptive degenerations" in every part of the plant. Conversely, a transference from water to land induces a tendency to restore the lost features, resulting, it may be, in a greatly enhanced and vigorous growth.

Whether there were several, few, or only one originally aquatic ancestor, though probability would suggest several, I would not even venture to guess; because it is impossible to trace affinities between the flowers of existing endogens and those of any existing orders of exogens; but that the theory I have advanced is at least a plausible one seems to me to be sufficiently established.

On the Division of Nuclei in the Mycetozoa.

By Arthur Lister, F.L.S.

[Read 2nd February, 1893.]

(Plates XXXV. & XXXVI.)

At a meeting of the Society on Dec. 1st, 1892, I exhibited a series of preparations showing the changes which took place in the nuclei of Mycetozoa previous to the formation of spores in the sporangium. I gave an account of my investigations on the subject, which I now offer in greater detail, together with observations on nuclear division in the swarm-cells, a point which I referred to at the meeting as requiring further elucidation.

In De Bary's work, dated 1884 *, he states :—" Nuclei were not at first observed in the plasmodia; Cienkowski even stated expressly that the nuclei present in the swarm-cells disappeared when they coalesce; Schmitz and Strasburger have recently established the presence of nuclei in the plasmodium, and it may be presumed that they are the persistent nuclei of the swarm-cells and the products of their division."

Strasburger published in 'Botanische Zeitung,' May 1884, his account of the development of the sporangia of *Trichia fallax*. He gathered a large number of sporangia in different stages of growth, and cut sections after hardening them by different processes and embedding in elder-pith. In some of these sections he discovered division of nuclei taking place with the now well-known figures of karyokinesis; and he states, "Very possibly this mode of nuclear division takes place only at the stage immediately preceding spore-formation; previously the number of nuclei did not appear to increase, whereas final division would be necessary to provide the smaller nuclei we find in the spores."

I exhibited at the meeting a photograph taken from a thin network of creeping plasmodium of *Badhamia utricularis*, killed with alcohol while the streaming was in full activity over a thin cover-glass, and stained with magenta, ×450. It showed the nuclei in large numbers. I also showed several of such films killed with Flemming's fluid stained with picrocarmine and mounted in balsam; these exhibited the vast abundance of the nuclei more clearly.

For several years past I have endeavoured to discover by what

* 'Comparative Morphology and Biology of the Fungi, Mycetozoa, and Bacteria.' Oxford ed. 1887.

process the multiplication of these nuclei came about. During this time I have made many stainings of the plasmodium of a large number of species, and though I have often seen appearances which implied that simple division took place, I was never able to detect the smallest indication of karyokinesis.

From the cultivation of plasmodia it was obvious that there was a continual increase in the number of the nuclei. *Badhamia utricularis* affords especial facilities for such cultivations, as it grows rapidly when supplied with such fungi as *Stereum hirsutum* and *Polyporus versicolor*.

In January 1887, I gathered the plasmodium of *Badhamia* from a stump in my garden, and from that time to the present I have had an almost continuous series of cultivations from that one source. I have sometimes had as many as 17 colonies growing at once; some of these would change to sporangia and some I allowed to dry into sclerotium, which at any time I could revive to replace those that had produced their spores *.

Stainings of the plasmodium made at any time of the year, and either immediately previous to the change to sporangia or weeks before, always showed the nuclei of the same character: they are about 3 μ in diameter, varying from 2·5 μ to 5 μ (Pl. XXXV. fig. 1); they contain usually a single nucleolus but sometimes two or three of smaller dimensions.

Considering that the plasmodium with which our stainings were made was suddenly killed when in full vitality and preserved so perfectly that the minute vacuoles in the thinnest parts of the film were distinctly defined, it is perhaps remarkable that we do not more frequently meet with unmistakable instances showing the nuclei in the actual process of division, but such is the fact. Although we know that rapid multiplication of nuclei must go on in quickly-growing plasmodium, we may search a mounting for a long time without meeting with the dividing stage; at the same time it is met with frequently enough, I think, to justify the conclusion that the nuclei multiply by simple division. Fig. 2, *a*, *b* (Pl. XXXV.), represent some of the forms in which such division appears to be going on. In almost every field of the

* The encysting of the plasmodium when it passes into the condition of sclerotium appears to be analogous to the formation of microcysts in the swarm-cells: a number of nuclei with the accompanying plasma are inclosed by a cyst-wall, which is either dissolved or remains persistent according to the species, when the sclerotium is revived; but there is nothing to lead us to suppose that nuclear division is involved in the process.

microscope we notice pairs in close proximity, often connected by a bridge of nuclear matter, if we may judge from its taking an equal depth of stain; this appearance is so frequently seen that it is scarcely possible to be an accidental arrangement, but suggests that division has occurred and that the two halves are not yet entirely free. Fig. 2 *a* (Pl. XXXV.) gives an earlier stage in which two nuclei seem to be clearly united. It is in the thin parts of the film, where the nuclei are flattened and the plasmodic granules widely scattered, that this condition can best be seen; in deeper parts it is very difficult to ascertain whether such appearances are not occasioned by two nuclei overlapping at their edges. See "Additional Note" at end of paper.

In a paper recently published in Cohn's 'Beiträge zur Biologie der Pflanzen,'* speaking of the plasmodium of Mycetozoa, Rosen states: "We may look in vain for nuclei caught in division. One may, indeed, without great error, put down the number of nuclei in a plasmodium as equal to the number of united single amœbæ which the plasmodium contains."

From my cultivations, in which the nuclei increase in number a thousandfold, it is evident that this view cannot be sustained; but Rosen's experience is interesting as showing the difficulty there is in detecting the mode of increase.

My figures are drawn from stainings made at Lyme Regis in Sept. 1892, in the preparation of which my son, Mr. J. J. Lister, assisted. On his return to Cambridge he made a series of experiments with two species of Mycetozoa with the view of finding the karyokinetic appearances described by Strasburger, following his method but extending his observations by noting the times when the nuclear changes took place in the gradual development of the sporangia ending in the formation of spores.

I give his account in his own words:—

"On Oct. 15, 1892, I collected a number of young sporangia which had emerged from an elm-stump in the Backs of St. John's College. Some of these were hardened in Flemming's fluid and others were kept to ripen. When mature they were identified as belonging to the species *Trichia varia*, Pers.

"On Oct. 18th a fresh crop of sporangia of this species appeared on the same stump, and from that day till the 23rd I made a daily gathering of sporangia and preserved them in the same manner.

* Cohn, Beitr. z. Biol. Pflanzen, Bd. vi. Hft. 2. Breslau, 1892.

"I cut sections of each batch, staining with borax carmine before embedding in paraffin.

"The sporangia gathered on Oct. 15 show the nuclei in various stages of division by karyokinesis.

"In the sporangia of the later gatherings the karyokinetic division of the nuclei occurred between the morning of Oct. 20 and that of Oct. 21. On Oct. 20 nuclei were scattered through the undivided protoplasm, while twenty-four hours later each nucleus was the centre of a young spore, distinctly separated from its neighbours, although no spore-wall could yet be seen.

"On Oct. 28th I found a crop of young sporangia on a rotten elm log, and brought it to the Laboratory to treat in the same manner as the Trichia. Part of it was allowed to ripen and was identified as *Arcyria incarnata*, Pers.

"At 2.40 P.M. development was progressing so rapidly that from this time until 5.40 a small group of sporangia was preserved every hour, namely, at 2.40, 3.35, 4.40, and 5.40. On cutting sections of this series, the division of the nuclei by karyokinesis was found to be in full progress at 5.40, while the sporangia preserved an hour earlier showed no sign of it.

"On Nov. 5 the process was repeated with a fresh crop of *Arcyria incarnata* from the same stump. Sporangia were preserved at 9.18, 9.55, 10.45, 11.25, and 12 noon.

"In this series karyokinesis was in progress at 10.45. The nuclei at the 9.55 stage show some indication of change, but none of them have reached the *metaphasis* of the process of division, while at 11.25 the *metaphasis* was finished and the protoplasm already aggregated round the daughter nuclei."

At Lyme Regis similar experiments were then made with *Trichia fragilis*, *Trichia fallax*, *Comatricha Friesiana*, and *Physarum leucophæum*; but instead of hardening the sporangia and cutting sections, the contents of the young sporangia were smeared over thin cover-glass and then treated with Flemming's fluid, stained with picrocarmine, and mounted in balsam.

The following records show the period when karyokinesis appeared:—

Nov. 13. A large growth of *Comatricha Friesiana*, just rising from rotten wood, was brought indoors and placed under a bell-jar.

12.45 P.M. The ovoid sporangia were nearly sessile, the dark stalks just appearing at the base. The staining showed the nuclei containing one to three nucleoli lying in a loose reticulum.

3 P.M., 3.45, 4.45, 5.45, 6.10. Nuclei with the same appearance as at 12.45.

6.45. The black stalk had elongated to four times the diameter of the globose sporangia, in which the dense net of capillitium had developed; nuclei unaltered.

6.55. The nuclei showed a changed aspect. Instead of containing one to three distinct nucleoli, they had a more uniform appearance. Although the objects are so minute that the structure is difficult to make out, they may be presumed to have reached the stage immediately antecedent to that described by Strasburger as the coil. A more definite coil stage was obtained in other series.

7.15. Nuclear spindles perfectly developed.

7.35. The two halves of the nuclear plate separating.

8 P.M. In the greater part of the preparation the spores had formed, each containing a small disk-shaped nucleus; in one part a less advanced stage appeared; the plasma was aggregated round the dividing nuclei in masses of two spores' capacity, the daughter-nuclei being widely separated; and elsewhere these masses were constricting to form the spores (Pl. XXXVI. fig. 9). A later staining showed the spore-wall forming, with the nucleus globose and increased in size. Next day the remaining sporangia of the gathering had perfectly developed the ripe spores.

Nov. 28. A cluster of *Physarum leucophæum* was rising in white knobs on a rotten stump, the stalks not having begun to form; they were placed under a bell-jar as in the last case, and smears were taken in the same manner. The first preparation was made at the time of gathering.

10.55 A.M. The nuclei had a loosely reticulated structure and contained one to four irregular nucleoli: the plasmodium was charged with refuse matter.

4.30 P.M. The refuse matter had been discharged from the sporangia and was stored in the short stalks which had now formed.

5.15, 7.30, 8.30. No marked alteration in the appearance of the nuclei.

9.10. The nuclei had a uniform granular appearance as if the network had broken up into numerous short rods. The preparation corresponded with that of *Comatricha* at 6.55. Numerous darkly-coloured small nuclear bodies were present in the staining. I will refer to these later.

9.50. The nuclear plate had divided, corresponding with the

Comatricha of 7.35. The stage showing the nuclear spindles, matching with the 7.15 staining of *Comatricha*, was missed in this series; but one of a less carefully timed preparation of another gathering of *Physarum leucophæum* supplied the gap. The small nuclear bodies (mostly contained in a vacuole) were numerous in this slide.

10.25. Young spores formed containing a small discoid nucleus, corresponding with the 8 P.M. staining of *Comatricha*.

10.40. Nuclei in the young spores spherical.

On Dec. 5 a piece of rotten wood bearing a crop of young *Trichia fallax* was placed under a bell-jar, and stainings were taken which showed karyokinesis about an hour before spore-formation; but it was not a healthy development, probably owing to their having been exposed to frost when the plasmodium was just emerging. However, on Dec. 12 a growth of upwards of 200 sporangia came up in rosy globules on the same piece of rotten wood, which had remained all the time under the bell-jar. This gave an opportunity for preparations being made under the most favourable conditions with no danger of the disturbance to which plasmodium is liable when removed from its natural surroundings. In addition to the interest attaching to *Trichia fallax* as having been examined by Strasburger, it is a species representing a group which are slower in maturing than *Comatricha* or *Physarum*; for whereas in the latter genera the spores begin to form within 12 hours from the time when the sporangia first make their appearance, in *Trichia* this process takes nearly four times as long and the spores are not fully ripe under about four days.

The following record gives the times when the sporangia were examined. It will be noticed that those taken at 10.20 and 10.40 on Dec. 13 do not follow in regular sequence, which is probably due to the fact that in this species the sporangia do not rise from the matrix quite simultaneously, so that some are rather more backward than others.

Dec. 12, 10 A.M. Sporangia of *Trichia fallax* rising in pink globes. Nuclei showing a reticulated structure and containing one or two nucleoli.

4 P.M. Sporangia ovate, stalked; nuclei as at 10 A.M.

9 P.M. No elaters formed, but vacuolar cavities showing in the protoplasm.

Dec. 13, 8.30 A.M. Elaters formed with rounded ends, no spiral markings; nuclei unaltered

1 P.M. Elaters pointed and showing faint spirals.

7 P.M. Elaters with well-formed spirals; nuclei unaltered; many small deeply-stained nuclear bodies distributed through the preparation (Pl. XXXV. fig. 3).

7.20, 8, 8.30, 9 P.M. No apparent change from 7 P.M.

9.30 P.M. The spindle had formed with a thick nuclear plate appearing as if composed of numerous short rods in confused aggregation; spindle-fibres distinct (fig. 5).

9.55. The two halves of the nuclear plate in different degrees of separation.

10.20. No spindles; a reticulum suggesting the "coil" stage, —a less advanced development.

10.40. The nuclear plate widely divided, a few retaining the spindle-form (fig. 6).

11.5. A remarkably beautiful and uniform preparation; all the nuclei of hexagonal figure, the two halves of the nuclear plate separated to the distance of their diameter; the spindle-fibres sharply defined.

11.27. Daughter nuclei separated, discoid (fig. 7).

11.47. No apparent difference from the last.

Dec. 14, 12.5 A.M. An appearance of spore-formation beginning.

12.20. A few spores seen of normal size.

1.15. Spores increased in number.

1.50. do. do.

2.15. Some spores showing a delicate spore-wall (fig. 8).

A large growth of *Trichia fragilis*, which emerged from rotten wood in October, gave sharp karyokinetic figures corresponding with those of *T. fallax* as far as stainings were taken, but they were not carefully timed.

Until quite recently I had not seen karyokinesis in *Badhamia utricularis*. I was particularly anxious to observe it in this species, because, as I have said before, I have cultivated the plasmodium for six years from one source and have made a large number of stainings of the creeping stage with the object, if possible, of detecting the dividing nuclei.

On Jan. 28 one of the cultivations, which had been fed on *Auricularia mesenterica* for some months, showed signs of changing to fruit, and at 10 o'clock at night it was seen to be concentrating into sporangia. At 4 o'clock the next morning between one and two thousand well-formed sporangia were hanging in clusters, like golden grapes, from the fungus on which the plasmodium had been feeding. From this time to 11.37 A.M.

the contents of a sporangium was smeared on a thin cover-glass every half-hour, and after 6 o'clock every quarter of an hour, and placed in Flemming's fluid. A check staining with acetic gentian-violet was made on each occasion to note any change that might occur. At 4.15 in the morning there was an indication of the formation of capillitium by the appearance of vacuolar spaces in the plasma, in which granules of lime, which abound in the plasmodium, were seen to be collecting. The nuclei had the same character as in the streaming plasmodium and, with the exception of the further development of the capillitium, there was no apparent difference in the successive stainings until 11.37. At this period the gentian-violet stain showed a changed appearance in the nuclei, suggesting that the "coil" stage had been reached. From 11.45 to 12.45, when spores had formed, smears were taken every two minutes. I have 37 stainings taken during this hour, and, with the exception of two which show only spores, we have in these mountings many thousands of nuclei in every stage of karyokinetic change. Four hours later the sporangia under the bell-jar were black from the dark-walled spores.

Rosen, in the paper before alluded to, describes his investigations relating to *Fuligo* and *Lycogala*, in which he observes that shortly before the formation of the spores a nuclear plate is formed, and that this plate divides and the two halves separate; but he did not succeed in making out the presence of the spindle-fibres. He agrees with Strasburger in supposing that there is a simplification in the karyokinetic process in Mycetozoa as compared with that observed in higher forms. He thinks the coil stage may be absent in this group, and further states that the smaller the nucleus the more simple is the process. I cannot think that this view is borne out by the preparations of the species I have examined. We have, in the first place, the change from the condition of the nucleus with distinct nucleoli lying in a close reticulum to that of a more uniform structure in which no nucleolus can be detected; we then see the chromatin matter withdrawing from the nuclear wall, and presenting much the appearance of a continuous coil (Pl. XXXV. fig. 4); this is followed by the formation of the nuclear plate, in which about eight segments may be counted when seen in profile; from this plate the spindle-fibres can be clearly seen converging towards a point at the opposite poles: then we have the stage when the nuclear plate has divided, the spindle-fibres are seen to connect the separated

halves, and also to extend to the now widely-diverging poles (figs. 6 and 9), while the nuclear wall has vanished; after this the spindle-fibres disappear, and each daughter nucleus becomes enclosed in a spore. The chromatin elements composing the nuclear plate, when seen under the highest powers, appear as elongated curved bodies, though their exact shape cannot be made out, nor can any indication of longitudinal splitting be detected.

From the appearances above described, there seems to be strong evidence that the process followed in these minute nuclei is of the same character as that observed in those of larger size.

I wish to call attention to a remarkable change that took place in the behaviour of the plasma of *Badhamia* at the time of the appearance of the spindle stage. Until the condition which I take to be the coil was reached, the plasma, when spread on the cover-glasses, was viscid and smeared with some difficulty, forming lumpy aggregations, but as soon as the spindle had formed it spread like cream in an even layer. The stainings showed, as had before been observed to some extent in *Comatricha* and *Physarum*, that at the time when the viscid condition ceased, the plasma broke up in irregular masses enclosing numerous nuclei with the nuclear plate in various stages of division; as the daughter nuclei separated, a further breaking up took place, until each dividing nucleus was surrounded by a definite amount of plasma of the capacity of two spores; this again constricted to form the spores. The process in these species is very rapid. In *Trichia fallax*, on the other hand, the plasma does not break up until the final spore-formation takes place and the daughter nuclei have separated *.

The small nuclear bodies before referred to seen in the preparations of *Physarum leucophæum* and *Trichia fallax* may, perhaps, be abortive nuclei. In *Comatricha Friesiana* they could not be found either before or after the formation of the spores, though more than 30 stainings of the critical stages were examined. In *Trichia fallax* they were not present in the earlier conditions,

* *Note.*—Since writing the above, we have made a successful series of stainings of the sporangia of *Didymium squamulosum*, *Craterium vulgare*, and *Badhamia panicea*. In all of these the breaking up of the spore-plasma took place in the same manner as in *Badhamia utricularis*, the dividing nucleus always being surrounded by a mass of two spores' capacity before the final division into spores.

but showed in considerable abundance when the elaters were forming (Pl. XXXV. fig. 3). They were, for the most part, more deeply stained than the normal nuclei and resembled oil-globules enclosed in vacuoles; intermediate forms showing more or less of reticulated structure were found between these and the well-formed nuclei. At the stage when the spindle occurred they were more faintly stained, and when the spores appeared they were often difficult to detect, although most of the spores contained one or two of them (Pl. XXXV. fig. 8). In *Physarum leucophæum* they were more striking than in the last-named species. In the first stage, when the sporangia were just rising, they were conspicuous by their dark staining, the absence of reticulated structure, and by appearing in pairs, often apparently adhering, the couples being surrounded by a hyaline envelope. Four hours later they were still more numerous, of the same character as in the former staining, and with the couples in great numbers. Two hours later again, when the nuclear halves had divided, they were no longer in couples, but so numerous that 30 could be counted in one field of the $\frac{1}{10}$ ob. gl. In another hour the spores had formed and a large number of them contained one or more of these nuclear bodies enclosed in a vacuole as deeply stained as the true nucleus.

These observations may not be of much value, but the objects are so striking that they can hardly be passed over without notice.

The experiments above described were made with three species of *Trichia*, one of *Comatricha*, one of *Physarum*, one of *Badhamia*, and one of *Arcyria*, representing genera of widely differing characters. They give essentially the same results and afford a definite confirmation to Strasburger's surmise that division by karyokinesis in the sporangia of Mycetozoa is only found immediately before the formation of spores. They also show that in the cases in which the stainings have been carefully timed this division occurs but once, and within an hour from the period when the young spores make their appearance.

We have now to consider the change which takes place in the nuclei of the swarm-cells when division occurs in those bodies.

I had by me a specimen of *Reticularia Lycoperdon* gathered in May 1890. Experience had shown that it is a species whose spores germinate rapidly and with great regularity, but as the specimen had been preserved in a dry cupboard in which naphthalin had been freely scattered from time to time, it seemed doubtful

whether the spores would have retained their vitality for so long a period. That they had done so was soon proved. On Dec. 3 I shook some of the spores into a watch-glass, giving one drop of methylated spirit to expel the air from among them, and adding about 10 minims of filtered rain-water; in a few hours the swarm-cells were hatched in great numbers; on the following day a large proportion of the spores were empty, perhaps nine-tenths of their number, and the water was milky with the multitude of swarm-cells in active motion. A drop of this water was placed on a glass slide and dilute acetic gentian-violet was added; the swarm-cells were instantly killed, retaining their natural form with the flagellum extended; in these the nuclei were faintly stained, but here and there a few cells could be noticed with the flagellum withdrawn and in process of dividing; some were of globular form, others had become oblong, and others again were constricted or were about to separate. In all these stages the nuclei were deeply stained, so that they could at once be distinguished among the host of flagellated swarm-cells by which they were surrounded, and each darkly-stained nucleus was seen to be in one or another state of karyokinetic change.

In some of the spherical cells the nuclear plate had formed, and was seen, in profile, to consist of about six segments (Pl. XXXVI. fig. 10); in others division of the plate had taken place and the nuclear halves had just separated (fig. 10, *c*); in favourable instances the spindle-fibres could be detected converging to the poles of the spindle. In the oblong forms the two nuclear halves had retreated to the distance of about four times their diameter, and where the stain was of the right intensity the spindle-fibres could be distinctly seen connecting the daughter nuclei (fig. 10, *d*). Where separation of the cells had nearly occurred the still deeply-stained daughter nuclei had a discoid or crescentic outline, and took an excentric position in the daughter cells at the most distant point of divergence from one another (fig. 10, *g*).

After the swarm-cells have completely divided, the nuclei soon lose the property of retaining the deep stain; it is only while the cells remain attached to each other, though ever so slightly, that their nuclei are conspicuously darker than those of the neighbouring cells.

On the third day after wetting the spores, the swarm-cells were in vast abundance in the watch-glass, and mostly smaller in size

than on the first day, possibly from the absence of nutritive matter; dividing-cells were observed, showing, as before, darkly-stained karyokinetic figures. There could be little doubt from their size that some at least of the dividing-cells were the offspring of a former division.

Spores from another gathering of *Reticularia*, collected nearly two years ago, germinated as quickly and showed the same karyokinetic process in the nuclei as in the former case.

Amaurochæte atra, collected last summer, produced swarm-cells a few hours after the spores had been placed in water; division began sooner in these than in *Reticularia*, with the same appearance of karyokinesis, the dividing nuclei taking a deep stain as before described. Although the swarm-cells of this species are much larger than those of *Reticularia*, they are not so favourable for observation, because the greater depth of granular protoplasm obscures the definition in gentian-violet stainings, at the same time the spindle-threads connecting the separated halves of the nuclear plate were clearly indicated in some instances.

Numerous experiments were made with the spores of *Chondrioderma difforme*; those cultivated in a hanging drop and supplied with a thin section of the testa of a cress seed gave the best result. Three days after having been wetted and when the swarm-cells were very numerous and chiefly in the amœboid form, they were killed with osmic vapour and stained with acetic gentian-violet. The nucleoli alone in the active cells took a deep stain, the rest of the nucleus being scarcely more coloured than the body of the swarm-cell; but when karyokinesis took place the stages were strongly marked, as in the other species.

Stainings were made with acetic methyl green, picrocarmine, and mauvine, but none of them answered so well as acetic gentian-violet; for, although it is unsuitable for permanent mountings, the deep colour which it immediately gives to the dividing nucleus, in strong contrast with those of the active cells, allows several hours of favourable observation before the preparation becomes obscured by the concentration of the stain.

In making smears of the sporangia of *Comatricha* for preparation in Flemming's solution, the stage of development was ascertained by staining the remainder with dilute gentian-violet, and it was interesting to observe how precisely the deep colouring of the dividing nucleus corresponded with the same stage of karyokinesis in the swarm-cells. Although the definition was not so

sharp as in the mountings in balsam stained with picrocarmine, it was abundantly sufficient to indicate the period at which it was desirable to make frequent preparations *.

In reviewing the observations recorded in this paper we find:—

1. Karyokinesis takes place in the nucleus at the time when the swarm-cell divides. From former observations we know that when the swarm-cells unite to form the plasmodium, their nuclei remain distinct and do not coalesce.

2. The examination of over a hundred stainings of streaming plasmodium in which we know that the nuclei have multiplied in vast numbers, and in which no indication of karyokinesis occurs, leads to the conclusion that they increase by simple division. Although from the nature of the case such division must be difficult to detect, we frequently meet with appearances which support this conclusion from actual observation.

3. Within one hour before the formation of spores in the sporangium, in other words, when division of the protoplasm into true cells takes place, we have again the phenomenon of karyokinesis.

Or, leaving aside the question of the sclerotium, we may further generalize thus:—

Whenever cell-formation occurs in the life-history of the Mycetozoa, the nuclei divide by karyokinesis.

Additional Note.—Since writing this paper, convincing proof has been obtained that, under certain conditions, the nuclei in the streaming plasmodium divide by karyokinesis.

Mr. J. J. Lister, of Cambridge, has just repeated experiments with the plasmodium of *Badhamia utricularis*. A portion of sclerotium of this species was revived, and the plasmodium spread itself in large fans over a thin cover-glass. Four of these films connected by veins of plasmodium were taken at the same time and killed with Flemming's fluid and stained. Two of the

* I have lately succeeded in making permanent mountings of the swarm-cells of *Amaurochæte* and *Reticularia* by the following method:—A drop of water containing the swarm-cells is mixed with a small quantity of Flemming's fluid on a square cover-glass; it is allowed to evaporate almost to dryness, sufficiently to permit the objects to adhere to the glass, which is then floated on a watery solution of Erlich's hæmatoxylin and stained for twelve hours, washed for two minutes, passed through alcohol from 30 per cent. to absolute, then through oil of cloves, and mounted in balsam.

The karyokinetic figures in these preparations show the spindle-fibres more clearly than in the best of the fleeting stainings with acetic gentian-violet.

mountings show the nuclei in the stage described in my paper, with no sign of karyokinetic change; in the other two mountings every nucleus is dividing by karyokinesis, some are in the spindle stage, in other parts of the preparation the nuclear plate has divided and the daughter nuclei are in different degrees of separation.

This throws important light on the subject, and modifies the conclusion expressed at the end of my paper. Whether we can accept this observation as explaining the entire process of nuclear multiplication in the plasmodium, or whether, as seems probable, there is also increase by direct division, is a point which requires further investigation.

EXPLANATION OF THE PLATES.

Plate XXXV.

Fig. 1. Resting nuclei from plasmodium (*a*) of *Badhamia utricularis*, (*b*) of *Trichia fragilis*.

Fig. 2. Nuclei apparently in process of direct division, from plasmodium of (*a*) *Badhamia utricularis* and (*b*) *Trichia fragilis*.

Figs. 3–8 represent successive stages of division of nuclei by karyokinesis in the young sporangium of *Trichia fallax*.

Fig. 3. Nuclei and "small nuclear bodies" an hour before nuclear division.

Fig. 4. Nuclei in process of indirect division: *a*, "coil" stage; *b*, between the "coil" stage and the "nuclear spindle"; *d*, *e*, "nuclear spindle," the nuclear wall still persistent; *c*, probably the foreshortened aspect of the spindle "*d*." (The chromatin elements in this fig. are represented as too globular and sharply defined.)

Fig. 5. Division rather further advanced, the nuclear wall having disappeared: *b*, the spindle *a* seen from the pole.

Fig. 6. The "nuclear plate" is widely divided into two parts by the separation of the daughter segments.

Fig. 7. The daughter nuclei have completely separated from one another, but are still disk-shaped.

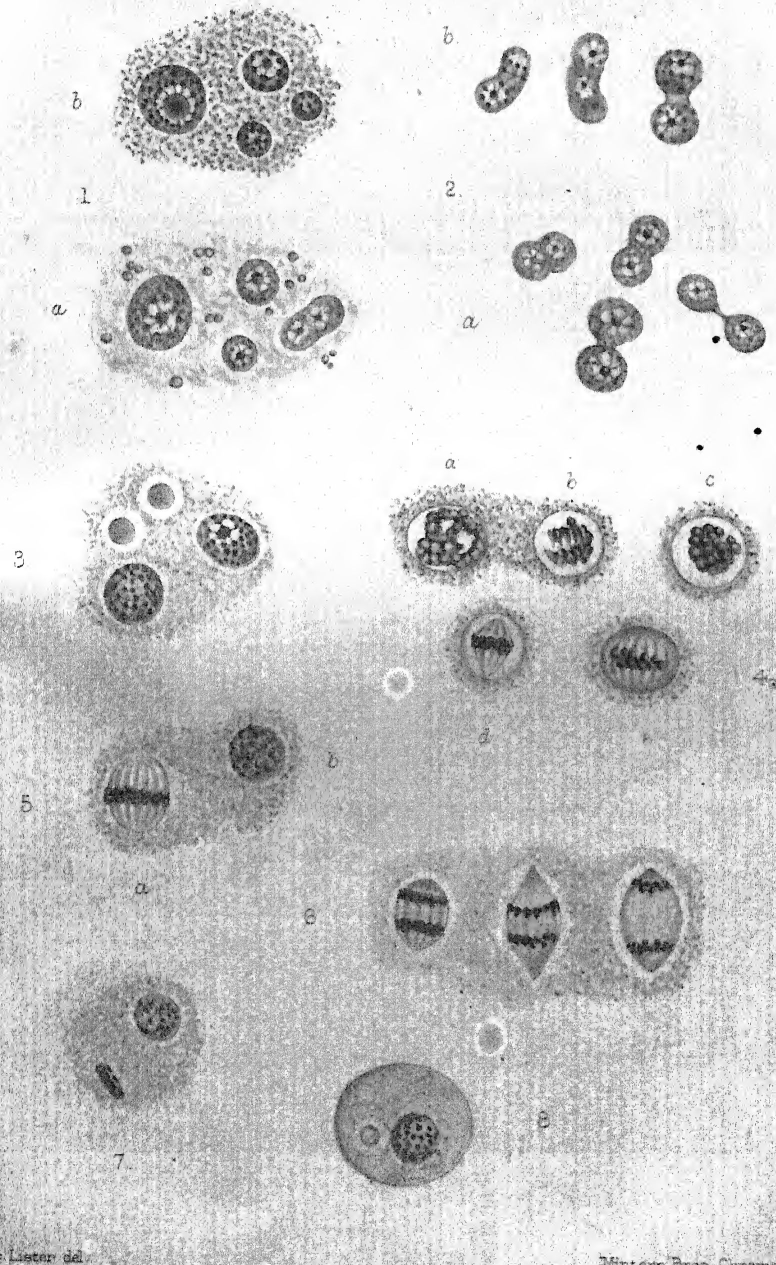
Fig. 8. A young spore containing a spherical nucleus and one small "nuclear body."

Plate XXXVI.

Fig. 9. Dividing nuclei, each contained in a mass of protoplasm of two spores' capacity, from the young sporangium of *Comatricha Friesiana*.

Fig. 10. Swarm-cells of *Reticularia Lycoperdon*: *a*, active flagellate swarm-cell; *b–g*, successive stages in division of swarm-cell accompanied by division of nucleus by karyokinesis.

Note.—Figs. 1–9 are drawn from preparations killed with Flemming's fluid, stained with picrocarmine, and mounted in Canada balsam. Fig. 10 is drawn from preparations killed and stained with acetic gentian-violet. All the figures × 1600.



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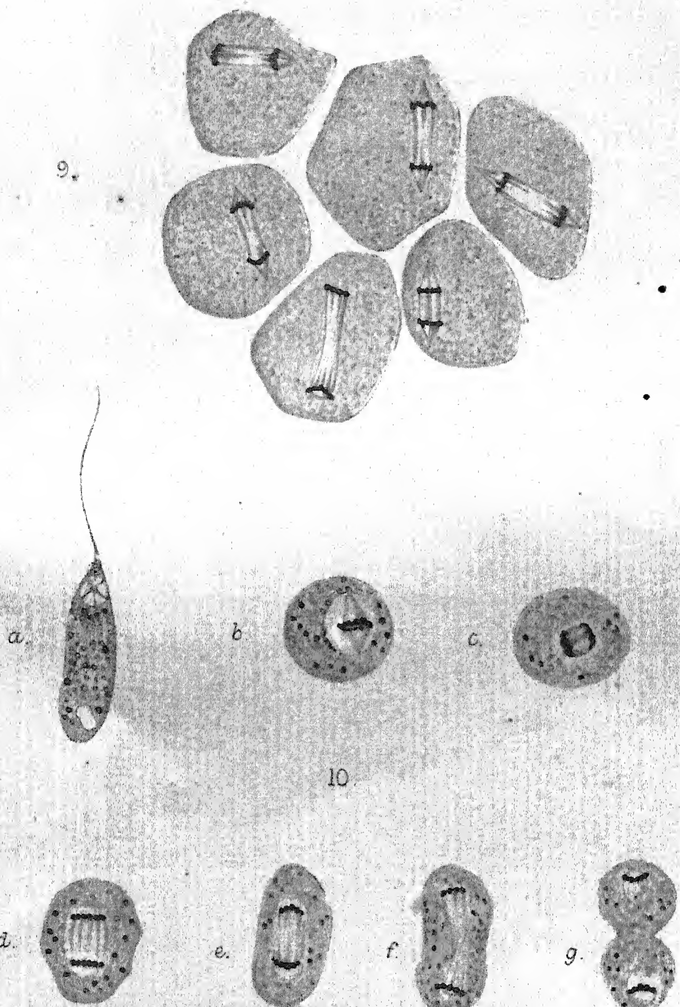
DIVISION OF NUCLEI IN MYCETOZOA.



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DIVISION OF NUCLEI IN MYCETOZOA.

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